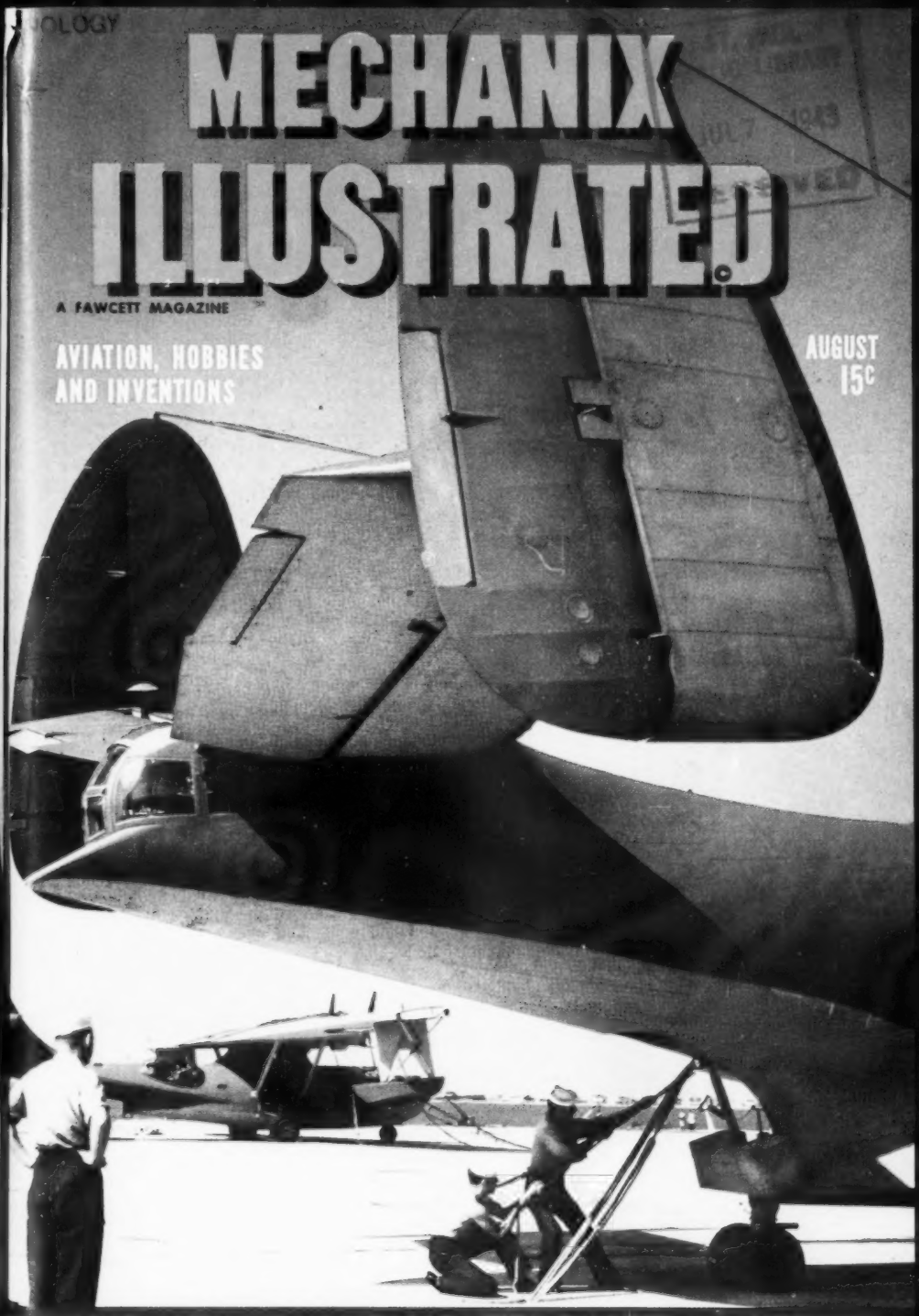
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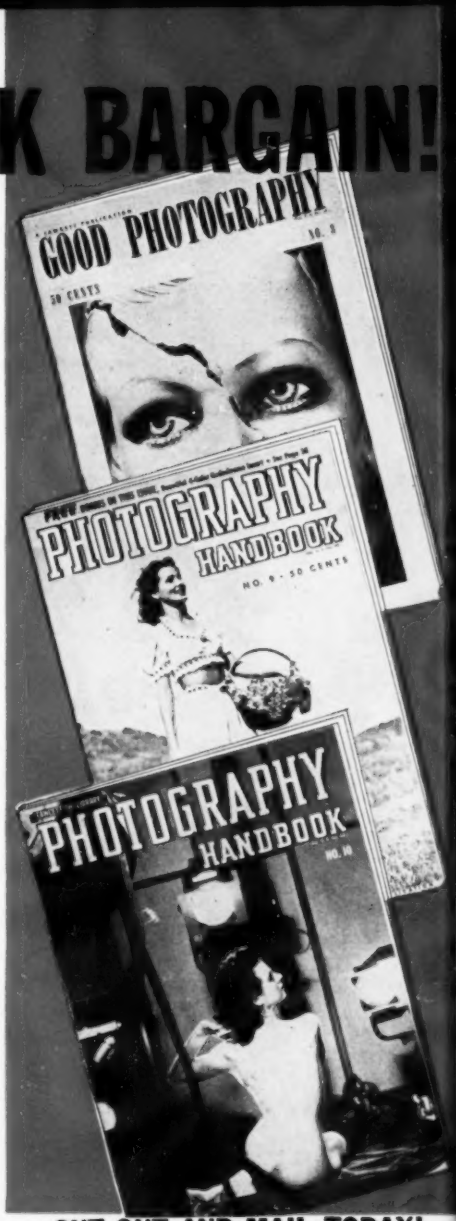

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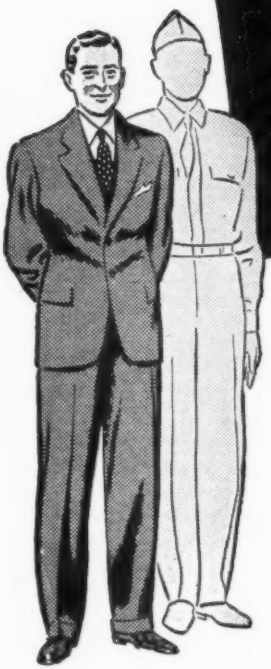

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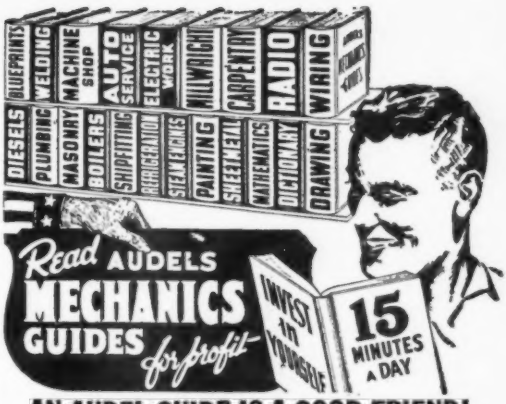

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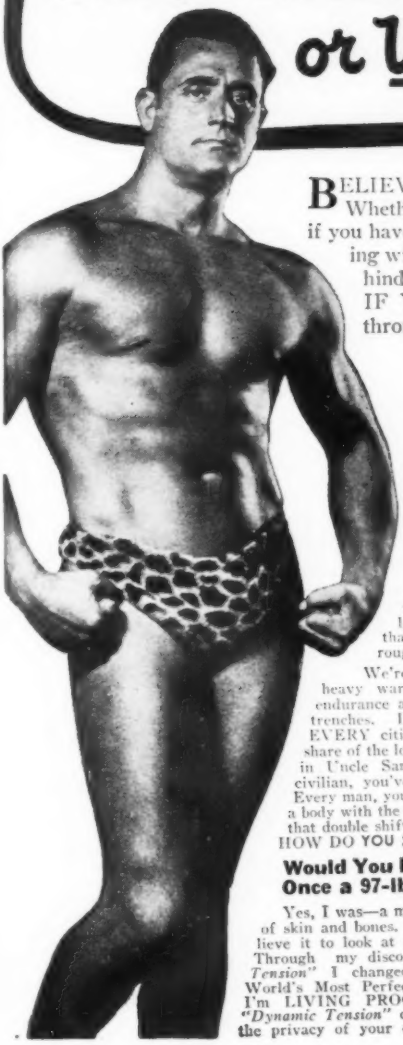
Behind Your Back--

WHAT IS SHE CALLING YOU—

HE-MAN or Weakling?



BELIEVE it or not—the girls are sizing you up *all day long!* Whether they look at you TWICE is up to YOU! They *will* if you have a rugged, healthy big-muscled HE-MAN body, glowing with strength and vigor. But they'll just snicker at you behind your back if you're a skinny, no-muscle WEAKLING! IF YOU, too, want to feel those admiring glances right through your back then listen to this:

Let Me Prove I Can Make YOU a NEW MAN—Charles Atlas

WILL you give me just 15 minutes a day of your spare time? That's all I need to PROVE—regardless of how old or young you are, or how ashamed you may be of your present physique—that I can give you a body men envy and women admire. Biceps that can dish it out, and a muscle-ridged stomach that can take it. A full, deep barrel-chest. Legs that never tire. A tough, sinewy back. An all-around physique that can laugh at ANY kind of rough going.

We're ALL in the Army today! The heavy war-time demands on strength and endurance are no longer limited to front-line trenches. It's only a matter of time until EVERY citizen is called to shoulder his full share of the load. And whether you do your part in Uncle Sam's Services or as a home-front civilian, you've GOT to be in 100% SHAPE. Every man, young or old, owes it to himself to get a body with the bulldog staying power that double shifts of working call for. HOW DO YOU STACK UP?

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YOUR INVENTION CLINIC

Conducted by

JOSEPH H. KRAUS

Mr. Kraus has been giving advice to inventors for more than 20 years. He will attempt to answer as many letters from inventors as possible in his column each month. Mr. Kraus will "call his shots as he sees them" in this column. Thoroughly versed on inventions and inventions procedure, he will never, under any circumstances, disclose any valuable secrets. He cannot answer questions relating to patent law. For such information, the Editors suggest you communicate with any one of the patent attorneys who advertise in MECHANIX ILLUSTRATED.

Mechanical Harmonica

B. C. Burton, Demaine, Sask., Can., writes: "Your judgment on ideas sent in for approval or advice seems always impartial and interesting. To me it seems that of all musical instruments a mouth organ is the easiest to play. Some years ago I got in touch with a patent attorney on an over-sized mouth organ. . . .'

Then follows a brief description of a bellows operated harmonica, details of which are not given here in accordance with our policy not to disclose ideas which we consider meritorious.

ANSWER: *We do not concur in the belief that the harmonica is the easiest instrument to play To play well requires ability and artistry. Nevertheless, we believe that the suggestion outlined by you holds considerable merit, albeit an educational campaign would have to accompany the instrument and a new school of technique would have to be developed.*

Aside from this you should carry on considerable experimental work to insure that the mechanical parts of this instrument will function properly. The information which you furnished disclosed none of these details but they are important. Our recommendation would be for you to develop the instrument. Do not just sit around and think about it!

Rowboat Paddle Drive

John C. O'Connor, Augusta, Ga., sends a drawing and description of lever-operated paddles for small boats to be used on lakes and quiet waters. He states: "I am enclosing a stamped, self-addressed envelope for your reply in the event I am unable to get my newsstand copy of M.I., which is limited now and goes like 'hot cakes' as soon as it hits the stands."

ANSWER: *The lever-operated paddle described in your communication would seem to us to be more of a construction short than a patentable unit. We are of the opinion that a patent search would undoubtedly reveal that this suggestion cannot be protected fully. This, however, is something for your attorney to decide.*

But your design cannot very well be commercialized. The sizes of the parts will vary with the size of the craft to which they are to be attached. The levers extend too far on the sides of the boat making it difficult to apply the thrust efficiently. The paddles will interfere with proper beaching of the boat. Some method should be included to return the paddle gate to a closed position instead of depending on weight or flotation to do this. We would not recommend further procedure.

And to insure your getting M.I. regularly, you can always enter your subscription.

Propeller-Setting Indicator

Emerson Boucher, Mechanicsville, N. Y., recommends that an indicating system be arranged on propellers and hubs to insure correct adjustment of hand-adjustable propellers. He states that he is 15 years old and that his father would pay for the cost of patenting the idea if we considered it valuable.

ANSWER: *We feel sure that there is nothing new or ingenious in the suggestion outlined. The indicating system is as old as the proverbial hills and could be applied to propellers by any manufacturer.*

Pipe Wrench

Joe Di Giancinto, Toughkenamon, Pa., submits a design for an adjustable pipe wrench for one hand operation. He states that he has built several models and finds that they work satisfactorily. He asks for our opinion.

ANSWER: *Perhaps your explanation is at fault. We can understand that the wrench can be opened easily to slide around the pipe but from the description we do not see how the jaws of the wrench can be tightened sufficiently around the pipe to start a gripping action unless they are squeezed together with the other hand. Minor changes could be made in the design to make it truly a one hand job.*

We would recommend that you have a patent search made. The wrench seems to possess sufficient merit to gamble with the small sum of money which such a search costs. If your attorney believes that the item is patentable further improvement and action would be indicated. But

[Continued on page 151]

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CHIPS *from the* EDITOR'S WORKBENCH

What's It Like To Be Wounded?

CORPORAL S. A. DAVIS was driver of the Command Car of a tank battalion that met General Rommel at Faid Pass, Tunisia. He had a front seat for the first great battle of this war between Americans and Nazis. The Battle of Faid Pass ended in rout for the Americans—the first and, we hope, the last defeat American arms will suffer At Faid Pass, the Americans were first blooded and learned the lessons of war that were to make them superior to the Germans.

Corporal Davis fought through the entire artillery, infantry and tank battle, with a detachment of half-track tank destroyers. At the battle's close, he was trapped by three giant Nazi tanks and fired at like a cornered rabbit. His half-track suffered three direct hits and was finally shot out from under him by a blast that tore off his right leg.

Next month, Corporal Davis, himself, takes you into the heart of the Battle of Faid Pass, describes the sounds, the sights, the smells and the feel of that Struggle of Titans and tells you what it's like to be on the receiving end of Nazi guns, in an MI "special" article. Be sure to get September MECHANIX ILLUSTRATED for his story, I Was Wounded at Faid Pass.

And Added Attractions

WE HAVE an extra batch of attractions coming up in the Crafts & Hobbies as well as the Feature sections of September MI. Here are a few of the five-star billings:

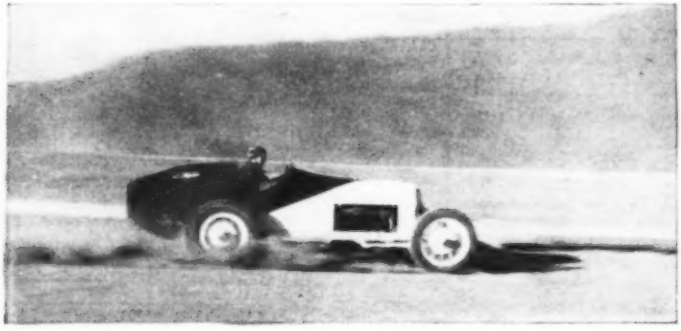
NEW HELICOPTER HORIZONS: by Captain Boris Sergievsky, as told to George Daniels. Captain Sergievsky, one of the world's foremost aviation authorities, here reveals for the first time anywhere the existence of a new type of helicopter built to rival the Sikorski helicopter now in use by the U. S. Army. His article will contain the first photographs ever published of this remarkable new flying machine. This, we feel, is another great MI scoop in the aviation field—the greatest since MECHANIX ILLUSTRATED brought you the first full story of the success of the Sikorski helicopter.

GAS BUSTERS: MI again shows you how to get around despite the gas shortage, this time with plans for building several lightly powered midget cars delivering unbelievable mileage. They're designed to be built with junked parts, too.

THE SCIENCE OF ROCKETS: Willy Ley, one of the world's foremost authorities on rockets and organizer of the first rocket society in Europe, tells you what makes rockets fly—plus the latest releasable information on rockets in the war. (Incidentally, see page 77 of this issue for an example of the way MI beats the world in publishing such news!)

NUMBERING MACHINE FOR YOUR SHOP: Owners of small workshops, particularly those engaged in spare-time war production subcontracting, will find this machine indispensable. It quickly numbers small metal parts, thus keeping an accurate and permanent assembly line record.

AN ADVENTURE IN COUNTING: Did you ever stop to consider how differently you would be counting today if man had twelve fingers instead of ten? Because he has ten fingers, man counts with a "system of tens." If he had twelve fingers, he would be counting with a "system of



Winner of the Workbench first award of $5.00 this month is the racing sport car, left. Built from a stock Model A Ford, it ran 28 to 32 miles per gallon at a pace of 50 miles an hour. Fuel used was 2 parts kerosene and 3 parts gasoline. The builders are Cpl. Francis Scatko, Pvt. Frederick Scatko, and Cpl. William J. Raeling, of 1118 Erie St., Utica, N. Y.

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Editor's Workbench Chips

twelves." F. Emerson Andrews tells you a lot of intriguing reasons why a "system of twelves" would be much better, in a story of number magic.

PLASTER MOLDING AS A WARTIME HOBBY: One material still amply available for the hobbyist is plaster. It can be used as the basis for a fascinating handicraft, as this article explains in full detail.

SOUTH AMERICA CALLING: Lilo Linke, noted South American novelist, introduces one of the most refreshing characters we've met in many a month. He's Paco Villar, the operator of a one-man radio broadcasting station in Ecuador. You'll recognize Paco as the South American version of the North American handyman—an ingenious cuss, always improvising, patching and odd-jobbing and somehow making a success of his radio station.

THE SCHOOL SHOP: Lesson No. 8 in a course of aviation instruction by Gilbert Paust, this installment will cover modern airplane instruments.

THE DRUGGIST'S MOTOR BIKE

R. H. Johnson, of the Courtesy Drug Co., Broadway & 5th Ave., Knoxville, Tenn., is the builder of this front drive motor bike. Motor, gas tank, and all turn with the handlebars when steering. The front drive permits the rider to help the motor by pedaling on steep hills. The bike gets more than 80 miles to a gallon, and does 25 to 30 miles an hour. It certainly is an economical delivery vehicle. A $3.00 Workbench award and a Certificate of Merit go to Mr. Johnson for this snapshot.

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Editor's Workbench Chips

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A World You Will Know

Next month, as noted above, we will run the final installment of the MI series, A World You Never Knew. We are prouder of this series than of anything we have published in our feature section for some time, for a number of reasons. Newspapers have credited MECHANIX ILLUSTRATED with originating the idea, "Buy War Bonds now so that you may purchase the new wonders we will produce after the war"—a theme now being carried out in many advertisements. MI was months ahead of any other magazine in picturing for you the wonders which will develop out of wartime research. Since our series started, the same idea has been used by many other magazines, including The Saturday Evening Post, Look, Collier's, Coronet as well as several publications in the science field, to name only a few. Copies of illustrations used in our series have been reprinted in scores of newspapers, including the St.

3-MASTED FREIGHTER

Roscoe D. Judd, 1327 S. Sheffield Ave., Indianapolis, Ind., built this beautiful model of a 3-masted freight ship. It took two months to complete the model, Mr. Judd tells us, as it was built carefully to scale—even the tiny rigging parts being exact. This snapshot nets Mr. Judd a $3.00 Workbench award and a Certificate of Merit.

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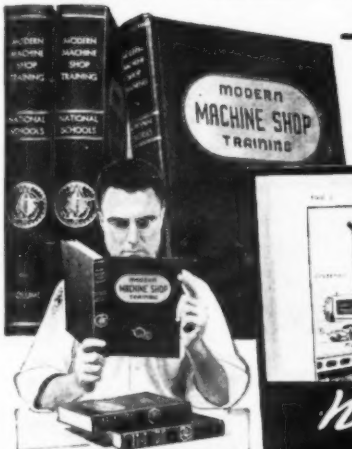

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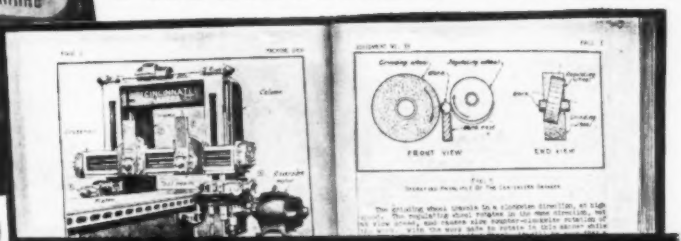

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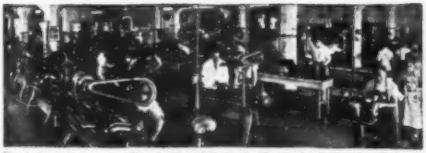

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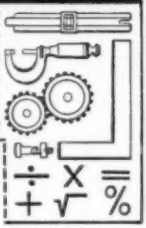

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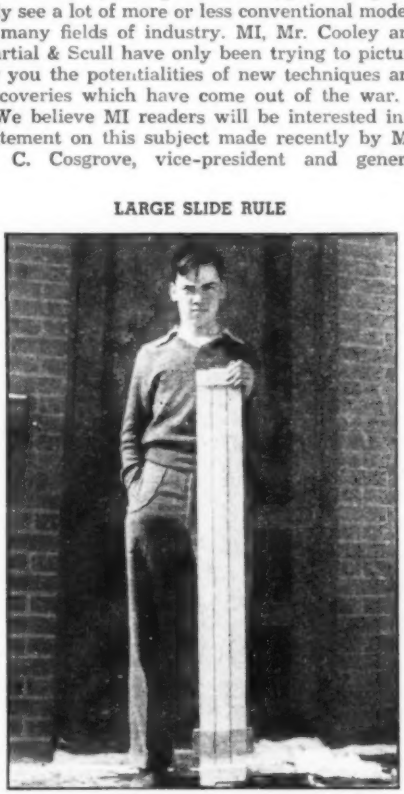
Editor's Workbench Chips

Louis Post-Dispatch, New York World Telegram, New York Post and others. The original art for the series was borrowed and placed on public display in the world's largest store, Marshall Field & Co., in Chicago.

Throughout this series, MI has attempted to keep before its readers the idea that the world cannot expect all of these wonders to blossom out suddenly, the moment the war is over. We feel the public should realize that there will be a transition period before industry can get into production with any radically new models, be it of automobiles, refrigerators or kitchen sinks. In the meantime, once peace comes, you will probably see a lot of more or less conventional models in many fields of industry. MI, Mr. Cooley and Martial & Scull have only been trying to picture for you the potentialities of new techniques and discoveries which have come out of the war.

We believe MI readers will be interested in a statement on this subject made recently by Mr. R. C. Cosgrove, vice-president and general

LARGE SLIDE RULE



Matthew J. Russel, 2921 North 46th St., Lincoln, Neb., made this 4-foot slide rule in two weeks' spare time. It contains the C and D scales at present, but Mr. Russel plans to complete it shortly. The rule is so accurate that 15-year-old Mr. Russel has been able to make use of it in school, where his physics teacher has employed it to teach radio classes how to operate the slide rule. A $3.00 Workbench award and a Certificate of Merit go to Mr. Russel for this snapshot of himself and his slide rule.

manager of The Crosley Corporation. Crosley has a "Committee for Tomorrow" within its organization planning post-war products and is as alive to the changes that are coming as any manufacturing concern in America. Mr. Cosgrove, we feel, has perhaps the clearest picture of exactly what will happen in production as the war draws to a close. He says:

"Some people feel that we may be making some civilian products within a year from now. The government has under consideration making available some materials for development purposes on peace-time household appliances next fall. If the attrition idea of warfare prevails, we may get into gradual production of peace-time products earlier than otherwise. If this is the case, we will be able to make the transition to peace-time production without much trouble.

"Within six months after we get permission to go ahead, we can be making domestic refrigerators. This doesn't mean the creations in plastic that have been pictured, but 1942 refrigerators with some few improvements. It will take an extensive period of testing before we would feel safe in going ahead on plastic refrigerators.

"Eventually, we will be having domestic peace-time appliances (refrigerators, household appliances, radios, etc.) such as had not even been

HOMEMADE ENLARGER

This neat looking enlarger was built by Leslie C. Cooke, of 429 Holcomb St., Watertown, N. Y. It handles films from 35 mm. to 4 x 5. A $3.00 Workbench award and a Certificate of Merit go to Mr. Cooke for this photo.

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Editor's Workbench Chips

thought of before the war—but not immediately.

"We are planning to keep employed, as all industry is planning, the many additional thousands of persons we have added to our payrolls for the war.

"Just after the war ends, there will be a huge pent-up demand for goods and war savings with which to buy them. After that, sales will not come so easily and they will require a lot of hard digging.

"We should be able to go back into civilian production by easy stages. Then we should go into rapidly accentuated yearly changes and improvements in products—but don't expect too great changes too soon after the war ends."

A Bow

Walter Winchell is the world's most widely read writer. We are especially proud, therefore, to have had him single MI out for comment in a recent column.

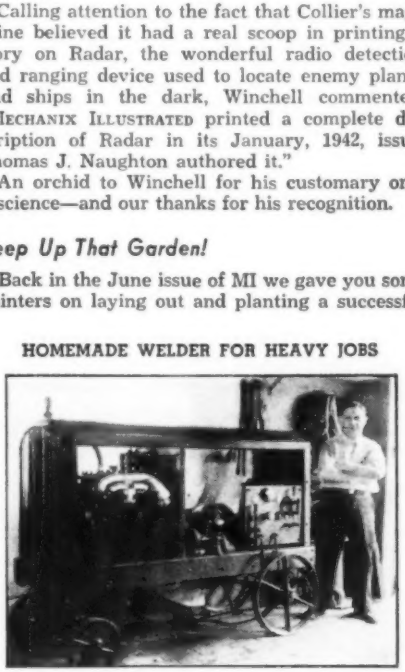
Calling attention to the fact that Collier's magazine believed it had a real scoop in printing a story on Radar, the wonderful radio detection and ranging device used to locate enemy planes and ships in the dark, Winchell commented, "MECHANIX ILLUSTRATED printed a complete description of Radar in its January, 1942, issue. Thomas J. Naughton authored it."

An orchid to Winchell for his customary omniscience—and our thanks for his recognition.

Keep Up That Garden!

Back in the June issue of MI we gave you some pointers on laying out and planting a successful

HOMEMADE WELDER FOR HEAVY JOBS



Perry G. Russell, 1315 Allegheny St., Jersey Shore, Pa., is the builder of this 200 amp. 45 volt welder. Made entirely from junk heap material, the machine has been in service for seven years. The main generator is made from the motor of an old battery driven car, rewound by Mr. Russell. He also has built several other welders, he tells us. A $3.00 Workbench award and a Certificate of Merit go to Mr. Russell for this snapshot.

Editor's Workbench Chips

Victory Garden. But your job isn't over once the seeds are sprouting—in fact then is when it's really just beginnning. Midsummer is the crisis time for the gardener; if he gets by this doldrum period he'll have a crop to harvest, otherwise his early labors are all for naught.

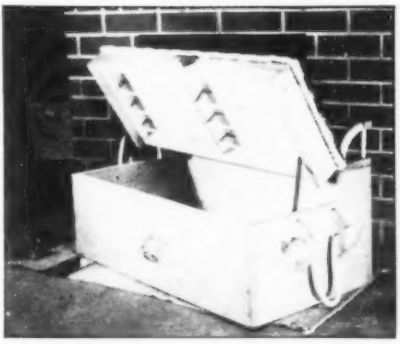
Weeds must be kept down, not only for appearance's sake but because they rob the crops of vital plant food and moisture. Every weed allowed to go to seed will be a hundred-fold menace next season. Insects must be fought to a standstill. Thinning must be carried on; staking of tomatoes and other plants is important, and some plantings may still be done for late gardens. Such things as lettuce, turnips, and Brussels sprouts do well in the fall.

Harvesting crops as they mature is important. Allowing them to become overripe, tough and woody is wasteful and inefficient. Better to give them away than to allow them to go to waste. Canning programs should be planned to use up every bit of surplus that can possibly be saved. Brining and drying should also be carried on with crops such as snap beans and corn unless a pressure cooker is available for canning. Where home freezing units or community lockers are available, great care should be exercised to gather the vegetables and fruits that are to be frozen at the exact stage of ripeness which combines the maximum of quality with fitness for freezing. There are several good bulletins available on freezing.

Bull's-eye

From way up n'oth in Anchorage, Alaska comes a letter of suggestion from an MI reader, G. R.

TOY SEA CHEST



Kenneth Albert, 3353 Disston St., Philadelphia, Pa., built this attractive little miniature sea chest for his small son. The top of the chest is upholstered so the youngster can use it as a seat when it is closed. White pine was the material used. Nice work, Mr. Albert. It nets a $3.00 Workbench award and a Certificate of Merit.

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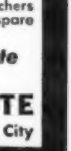

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Editor's Workbench Chips

Millspaugh who has an idea we think some of the rest of you may find interesting. We quote: "The March, 1943, issue of MECHANIX ILLUSTRATED described a Protective Alarm System designed by Walter E. Burton. The following improvement may be of value to some users of that system.

"To obtain the bull's-eye visual indicator showing exactly which loop of the alarm has been interrupted, and consequently showing at a glance *where* the intruder is entering, you need only make a few simple additions.

"Install a relay which has a high resistance coil across each loop of the system. The relays used may be of the single pole single throw type, but the contacts should be open when no current is flowing through the winding. In series with the contacts on each relay, connect a light bulb and battery. House lighting may be used instead of the battery, depending on the type of bulb employed.

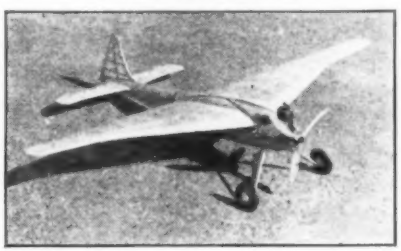
"The bull's-eyes may be placed at any convenient spot in the building or home; or several sets of bull's-eyes may be wired in parallel and distributed about the building, according to the service the owner desires."

[The article referred to above appeared in the March, 1943, issue of MI, on page 120.—Ed.]

Mending Wall Cracks

WHEN a rough plastered wall is sound except for narrow cracks running through it, these cracks may be mended by careful application of a crack filler. To prepare the crack, use a sharp pointed knife to clean any loose plaster away and also to remove a little of the plaster below the surface so that the crack is wedge-shaped and wider at the bottom. Do not, however, widen the crack at the surface if at all possible. When you have cleaned the crack, work a thin mixture of flat paint into it and leave until dry. The paint gives a firm foundation for the filler and prevents

B. H. GUION'S MANTA



This trim Manta model is the work of B. H. Guion, 1320 7th St., Corpus Christi, Tex. Mr. Guion tells us that the ship flies well. It certainly looks nice, and brings Mr. Guion a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

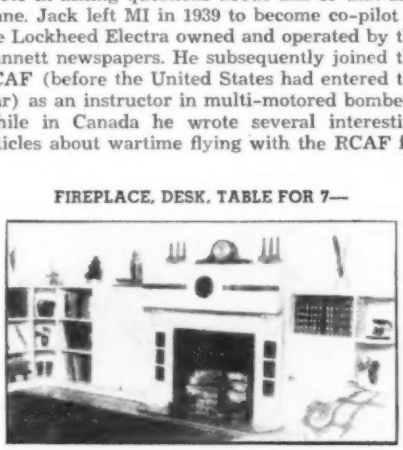
the absorption of the oil from the filler by the plaster. This step is of utmost importance in repairing the crack. To make the crack filler, twelve and a half pounds of heavy paste white lead is combined with a quarter pint of flatting oil which has been blended by adding whiting a little at a time and stirring smooth. After combining the two mixtures, work in a small amount of pale drier and combine thoroughly. The resulting mass should be putty-like and will keep indefinitely if stored in a covered can with water poured over the top. As you use it, pour off the water, level the top of the mass and re-cover with water. Work the mixture carefully into the crack, filling it firmly and with the knife smooth or roughen, as need be, the surface to follow the irregularities of that section of the wall.

MI in the Army and Navy

MECHANIX ILLUSTRATED is well represented in the Services, and here are the latest reports on four of our former editorial staff members, whom quite a few of our readers will remember via correspondence, by-line articles, etc.

Many of our older readers will recall MI's previous aviation editor, Jack Scherer, whose sound and helpful knowledge of flying matters was shared by literally thousands of aviation fans who wrote in asking questions about this or that airplane. Jack left MI in 1939 to become co-pilot of the Lockheed Electra owned and operated by the Gannett newspapers. He subsequently joined the RCAF (before the United States had entered the war) as an instructor in multi-motored bombers. While in Canada he wrote several interesting articles about wartime flying with the RCAF for

FIREPLACE, DESK, TABLE FOR 7—



E. W. LaRock, R. R. 1, Box 57, Wantagh, L. I., N. Y., is the builder of this interesting and attractive fireplace ensemble. Panels beside fireplace open to form a table for 7 people, and a pigeon hole desk. Lights of different colors illuminate the glass panels on each side of fireplace—colors to suit the occasion. As the entire unit is decorative, wood was used throughout, and second-hand wood, at that. Nice work, Mr. LaRock. It nets a $3.00 Workbench award and a Certificate of Merit.

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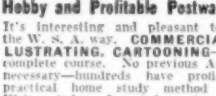

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Editor's Workbench Chips

MI, Air Trails and other magazines. After Pearl Harbor he was transferred to the U. S. Army Air Corps with rank of First Lieutenant and sent to India with a bombing squadron.

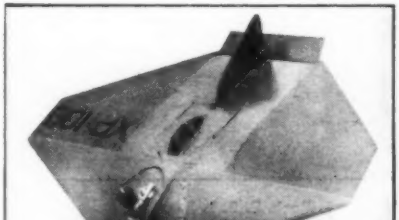
About two weeks ago we had a letter from Jack, written just after he had returned from a successful raid blasting the Japs in Burma. He's been recommended for the Air Medal, Distinguished Flying Cross and a Captain's commission. We hope he's received all three by now and want him to know that all his friends both inside and outside MI are right proud of the job he's doing.

No. 2 on our list is Robert Hertzberg, for three and a half years editor of this magazine until called to the colors in the fall of 1940.

The Signal Corps has thought well of Bob's abilities as a radio technician and administrator, and has promoted him steadily from the rank of Lieutenant. His latest boost, about a month ago, made him a Lt. Colonel, and there's no telling where he'll stop. Personally, we doubt if it will be this side of a Star. Col. Hertzberg is in charge of the Signal Corps Officers' Training School in Britain, and some of his graduate students helped bring about the Tunisian victory.

Formerly MI news editor and feature writer, Cliff Taylor was inducted as a private in May of last year. He went into Field Artillery and did so well that he was sent directly from basic training to Officers Candidate School. Commissioned a second Looey last November, Cliff is now learning to be a pilot with the aerial observation branch of the Artillery deep in the heart of Texas. His job, when his training is completed, will be to hover over enemy lines in an unarmed light plane (like the Aeronca that's being given away as first prize in the MI Buildwords Contest) reporting shell bursts and directing his battery's fire until he's chased by enemy pursuit planes or ack-ack. It's a nice quiet, safe job, yeah man, but Cliff is just the lad who can swing it.

GAS POWERED MODEL FLYING WING



Ellsworth Miller, 20069 Lichfield Rd., Detroit, Mich., built this trim and unusual gas powered model flying wing. Definitely new, this little ship should prove a fascinating U-line job. It brings Mr. Miller a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

Maxwell Hamilton's name was never on the MI masthead, though he was Acting Editor for a year after Hertzberg left. His monicker, however, appeared on numerous MI feature articles including I Flew My First Time Up, which many of you will recall. Max was commissoned a Lieutenant j.g. in the Navy some five months ago. He dropped in at the office the other day, having just finished his training in Communications at the Navy's Harvard school. He'll be stationed in New York "until further notice." After that he has no idea where he'll be, but we'll bet it'll be some place between Dakar and Darwin. Max is a cool customer though, of the Humphrey Bogart type, and no matter where he is we know the Navy won't be getting its signals mixed at that spot.

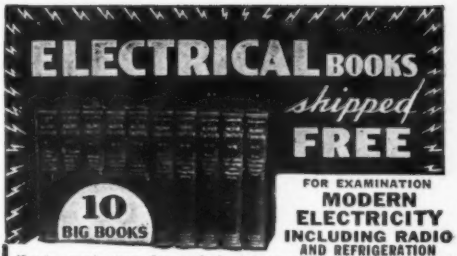
Auto Batteries Lose Charge Slowly In Low Temperature

The automobile storage battery loses its charge on standing three times as rapidly at 100 degrees as at 70 degrees Fahrenheit, but at 32 degrees the loss is extremely small. These are results of tests carried out by A. C. Zachlin of the Development Laboratory of the Willard Storage Battery Co., and reported to the Electrochemical Society.

Around 70 degrees, the usual automobile battery loses on standing about 1% of its charge per day, Mr. Zachlin said, so that at this rate it would in three months become practically discharged. The moral evidently is, if you have to store your car, store it in a cool place, preferably where the temperature is kept only slightly above freezing.

If the plates of a battery are made of pure lead, Mr. Zachlin pointed out, the loss on standing is reduced to practically nothing—to less than 15% per year. But pure lead is too soft for automobile batteries and it is customary to use lead containing 6% to 12% antimony. It is this antimony, he indicated, which is responsible for the discharge on standing.

It takes seven rabbit pelts for an Australian soldier's hat—but Australia has plenty of rabbits.



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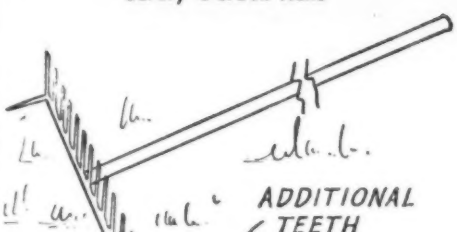
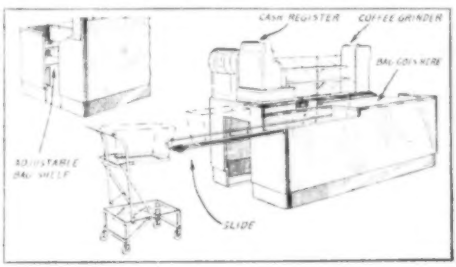
Popular Patents

Safety Garden Rake



Did you ever have a rake which some one (perhaps yourself) had carelessly left lying in the grass, teeth up, suddenly rise up and wallop you on the back of the head when you stepped on it in the dusk? Avoidance of such home mishaps as this is aimed at in a very simple invention on which patent 2,314,620 has been granted to Yorke G. Jander of Greenwich, Conn. Mr. Jander has simply provided two additional teeth at the ends of the rake-head, which stick straight forward, in line with the handle and at right angles to the other teeth. They effectually prevent the rake from pivoting on its own back and treacherously assaulting you from the rear.



No more Heave-Ho in super-markets according to a recent patent granted to Hartley Jackson and Leonard Milgram of Kansas City, Kansas. In the usual type of self-service store it is usually necessary to lift a filled wire basket of goods from a shopper's carriage onto the counter, check the goods and bill the items, and then separately lift each item into a bag. The novel counter of the patent has a low level basket slide for receiving the basket from a carriage. The groceries are checked on the slide and then are filled into a bag which is supported on an adjustable level shelf. For large bags to hold many items, the shelf is set at a low level. The bag opening is maintained substantially at the level of the counter. (No. 2,286,548.)

Popular Patents

Compact Flash-Bulb Unit

A compact unit for photographers making pictures by means of flash bulbs is the subject of patent 2,314,829, obtained by Robert H. Hunter of Cleveland. It combines a more accurately curved reflector, designed to get maximum value out of the light from a small flash bulb, with a new device for "spotting" the subject. Just within the lower edge of the reflector is another, smaller reflector, in which an ordinary flashlight incandescent bulb is mounted. This throws an accurately directed small beam of light parallel to the axis of the camera's focus, helping the photographer to get his picture properly centered.

Colored flames of electrical discharge can be generated from the finger tips by means of a new apparatus patented by Henry Transtrom of Glendale, Calif. The person who makes the demonstration wears either metal or fabric conducting type finger caps. Then by standing with either bare feet or with metal-soled shoes on bare feet on a high frequency electrical oscillator, an electric current is given off in a corona discharge from the finger tip caps. Normally the discharge is white, but flames of different colors may be discharged by applying different chemicals to the surface of the cap. (No. 2,277,187.)

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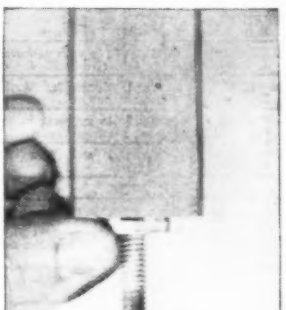

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Plastic Tubes To Save Metal

Collapsible plastic tubes may soon replace the metal ones now used for tooth paste, shaving cream, medications and similar products, for, even though consumers have to turn in an old metal tube for every new one they buy, metal is getting scarce. Shown in the above picture are two of the new plastic tubes, which are expected to be in full production soon.

Band Sander Fills Important Workshop Needs

A new band sander now available is said by the manufacturer to fill a need long known to the shop-worker and home hobbyist. The new machine, by using various kinds of abrasive bands, sands, grinds, carves, saws, shapes, profiles, cleans castings and machined parts, and buffs and polishes in wood, plastics and metal.

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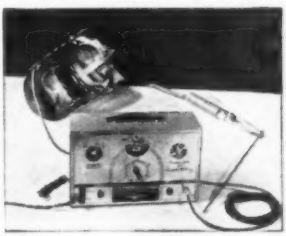
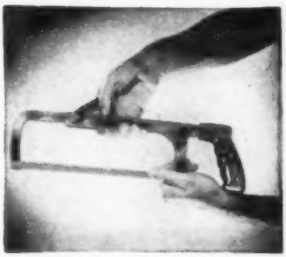
Welding Monitor



One of the most recent contributions to the welding industry and defense training is this newly introduced welding Monitor. The dial in the center of the Monitor is to select correct voltages for bare or covered rods or rods of different composition. The two instructor lights, shown above the arc voltage selector, operate simultaneously with those in the welder's helmet. When both bulbs are dark the arc is being held at the desired voltage indicate by flashes when arc is incorrect.

New Hack Saw Frame



All loose blade studs and threaded tension devices have been completely eliminated in a new type of hack saw frame, shown above, which releases or sets up blades by a simple cam-action lever-lock. Blades can be re-positioned to face in any of four directions; the length of the frame can be altered to fit 8", 10" or 12" blades by a simple adjustment.

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WIN THE WAR AT HOME

BY W. H. FAWCETT, JR.

PRESIDENT OF MECHANIX ILLUSTRATED

HOW about you city people spending that vacation on a farm? You will be doing a patriotic service to your country and you will be building up your health. Your country is especially making this appeal to the women. It's hard work—no one will deny that—but those who like to be in the open; who like to work with animals and growing things; who want to speed victory while improving health; will find many compensations. Business women, school teachers, career girls and housewives who cannot devote their whole time to war work can do a swell service to their country by spending weekends or several weeks helping to harvest the crops that mean so much to victory. School and college girls can sign up with the Victory Farm Volunteers of the U. S. Crop Corps. Women who can give a few days or a few weeks can register with the County Agricultural Agent or the U. S. Employment Service. An estimated 300,000 women will be needed to pick fruit, grade and pack fruits and vegetables, husk corn and do the many other harvesting jobs. Don't fail to give a helping hand in this important work. Help harvest a holocaust for Hitler!

—★—

Don't let that old bicycle with the broken sprocket go to rust. You won't have any trouble fixing it up because bicycle parts are not rationed. Maybe you've already patched yours up, but a lot of people haven't. The ODT estimates there are several hundred thousand bikes that could be reconditioned. If you don't use yours, sell it to a war worker who will be glad to get it.

—★—

In 1942, Dale Fields headed the Victory Book Drive in his home town of McPherson, Kan. This year he was a soldier aboard an army troop transport en route to Hawaii. One day he went to the ship's library for something to read. He found a book that had been donated in McPherson. The donors had written their names on the flyleaf. They were his parents. . . . The armed forces still need books. Give another one today.

—★—

I know it's hard to curb that wanderlust when vacation time comes, but try to keep off the trains this summer. They are needed by essential riders, such as men and women in the services and war workers. The Office of Defense Transportation has asked me to pass along to you these ten points:

1. Spread vacations throughout the year; don't insist on July or August. Try fall, winter instead.
2. Begin and end your holiday in mid-week, to cut the peak load at weekends when three-day Army passes are issued.
3. Vacation as near home as possible.
4. Remember no additional rail service to resort areas will be provided.
5. Avoid overnight trips whenever possible.
6. Take box lunches when you travel, to leave room in the dining car for hungry service men.
7. Curtail all unnecessary travel; consult your conscience as to whether the trip you plan is really necessary.
8. Don't plan weekend trips.
9. All conventions should be cancelled.
10. Take the inconveniences of traveling in wartime cheerfully.

—★—

Here's discouraging news. While six out of every ten housewives are saving waste kitchen fat, officials say only three out of ten have been delivering it to meat dealer collectors. All you have to do is strain waste fats of every kind into a clean can and take it to a meat dealer. Thirty-one tablespoonfuls of fat make a pound—which can produce enough sulfa drugs to save a soldier's life or enough gunpowder to load ten anti-aircraft shells. Remember this the next time you start to throw away any fat.

—★—

Here's good news. Thirty-three years ago, a young woman in Sunbury, Pa., who now is 67 years old, began saving her silk stockings. She wanted some day to knit them into rugs. Recently she turned them over to the war salvage drive. There were—count 'em—750 pairs. Said she: "I'd much rather see parachutes for the boys at the front than rugs."

W. H. Fawcett, Jr.

WE RAMMED THE SIXTH ONE!

The U. S. Coast Guard cutter Campbell, an unwelcome sight for Nazi subs, rides a rough sea in the North Atlantic.

by Seaman William Melchior, U.S.C.G.

In a single day not long ago the Coast Guard cutter Campbell saw more action than most ships ever see—six attacks on U-boats, and certain victory over one. Here a member of her crew tells the story of that day.

Seaman William F. Melchior, U.S.C.G. "All our guns were blazing away—"

SOMETIMES you get no glimpse of the enemy for many days, and then, wholly unexpectedly, you're in among them neck deep, battling desperately for your life. That's how it was with us. For 12 hours we had been hunting U-boats in an area where they had been reported and six times the gong had sounded the alarm for general quarters. And each of those six times the alarm had passed with no sign of submarines.

The Coast Guard cutter Campbell was one of the smaller ships in a convoy escort in the North Atlantic, when, late one night, the Commander of our escort armada sent us on a special mission away from the convoy to a near-by area where the presence of submarines was suspected. We steamed away 25 miles or more to investigate, and cruised around for 12 hours without finding anything, though we had six alarms during that period.

Our Skipper, Commander James Hirshfield, deciding that we had been on a wild goose chase, had just started us back to the convoy when the fun began. The sea was rough and the Campbell was wallowing in the heavy swells when suddenly the submarine detector whined again. Immediately the gong clanged another general quarters; the crew rushed to

battle stations, and the Campbell dashed at full speed to the alarm area.

Our searchlights played over the waters and far out on the horizon they picked out a dark object, forming a low line on the ocean. It was the prey we were hunting: a submarine. As we leaped toward the enemy, our guns burst forth in a fury of firing as soon as he was within range.

But before we could get close enough to make our barrage effective, the Nazi dived out of sight. We came over the spot where he had been and our K-guns kicked over a pattern of depth charges as we criss-crossed the area. Huge geysers of green water rose high into the air and the Campbell shuddered as the exploding ashcans blasted the waters below.

We were still circling in the churning sea when our wireless received a call for help from a corvette battling another submarine. Commander Hirshfield rushed to the aid of the smaller ship and the Nazi ran.

That was during the night. Early next morning, we spied our third U-boat on the surface. Once again our engines drove us at full speed toward the enemy and again the sub dived before we could get within effective range. Our K-guns laid another pattern of thundering ashcans and the ship shook as columns of water erupted from the sea.

This job done, we wiped our hands clean and started to rejoin the convoy escort. Three attacks on U-boats is a good day's work, but we had not gone far when a fourth sub appeared on the surface. He was too distant for our guns to bear down properly and submerged before our missiles could strike him. Our ashcans pounded the depths and we proceeded once more.

I had just about settled myself comfortably late in the afternoon when the clanging ding-dong brought me to my feet again. I ran toward the flying bridge and climbed to my battle station. As I reached it, I saw the fifth U-boat to port, riding the waves not too far from us. Almost as soon as the submarine was seen our guns went into action.

But the U-boat had no intention of fighting back. She crash-dived. The sub's stern was hardly out of sight before our K-guns kicked over and sent ashcans into the depths. We continued on toward the convoy.

It was about 7:30 p. m. and we had almost reached the convoy when the bo's'n piped: "Get ready; submarine in the vicinity." This had been going on for 24 hours or more and we had been on the alert all that time. I reached wearily for my sheepskins and waterproof gear, donned my arctics and waterproof hat, and pulled on my life-jacket.

It was a nice clear night and the men lolled around the main and berth decks, waiting for the call to general quarters. I went to the CPO quarters, my ordinary station, and picked up an orange to eat while I was waiting. The waiting made me restless.

Then I went to the main deck amidships. I was near the starboard lifeboat at 7:45, but no submarine had been sighted yet. I was leaning against the deckhouse five minutes later when the gong suddenly began clanging the call to general quarters.

I ran for the flying bridge, climbing the

Commander Hirshfield, foreground, remained at his post though wounded, saw his ship through.

Continued

We Rammed the Sixth One!

Fireman Colin Swindell prepares to float a cork and line through the hole in the hull.

ladder as fast as I could go. Half way up, I heard some of the men yelling and I turned to see what they were shouting about. For a moment, I hung as if frozen. For almost on top of us, it seemed, was a U-boat, sharply etched in the glare of our searchlights.

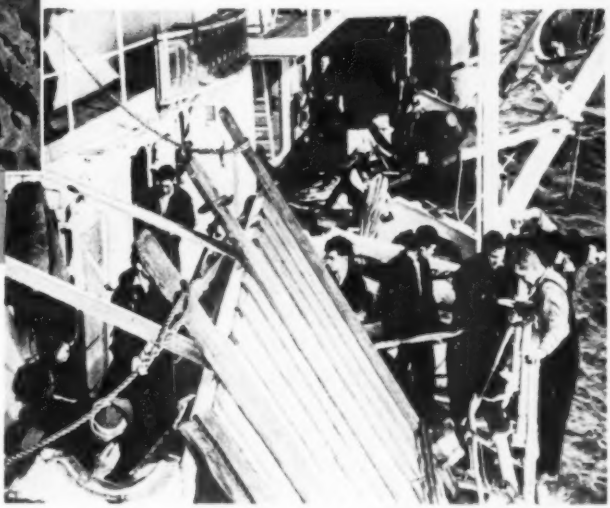
All of our men were shouting in their excitement by this time. "Ram that ——— — ———!" they were screaming and "ram the goddam sub!" The U-boat was so close that a collision seemed inevitable.

The Skipper steered the Campbell on a direct collision course and, with engines at full speed, the ship almost jumped as she headed toward the sub. All our guns were blazing away. The U-boat was in the center of a concentrated mass of flashing fire and roaring explosions, but we were almost on her so soon that our guns had to stop firing. The target was too close.

And then in a matter of seconds, giving us hardly a chance to brace ourselves for the shock, the Campbell's bow struck the sub, catching it a glancing blow amidships. Up on the flying bridge we did not feel the impact much, but down below the shock was so great that many of the men were knocked off their feet.

The submarine drifted free and immediately our guns started firing again at point-blank range. Not a single missile from our armament failed to hit the U-boat, which shuddered again and again as the shells tore her above and below the waterline. All of our guns were effective, but one gun crew stood out because of the terrible damage caused by their accuracy. This was a crew composed entirely of colored men, who did themselves really proud.

This U-boat had a huge conning tower and heavy armament, but she never got a chance to use it. The men in the Negro crew were sending shell after shell



The Campbell gets emergency repairs after battle. Crew puts cofferdam over side to plug 12-foot hole caused by her sub-smashing collision.

right into the conning tower and into the hull below the water line amidships. The Nazi listed to port and then her after end started to settle.

After our guns had fired about six rounds, Germans began to pour out of the sub's conning tower. I saw one standing on the deck, seemingly bewildered by the suddenness and fury of the attack. Even as I watched, a three-inch shell struck him squarely from in front. There was a flash of fire and a terrible explosion, and when the smoke had cleared there was no sign of him. He had disappeared as though wafted away by a magic wand.

As soon as the sub crew started piling out on the deck, our small arms raked them with a shower of bullets. Three or four of them dashed to their forward deck gun, but we mowed them down before they could get into action.

The U-boat was helpless under our concentrated fire and [*Continued on page* 150]

MATTER—INSIDE OUT

by Willy Ley

SOMETHING fell out of the sky.

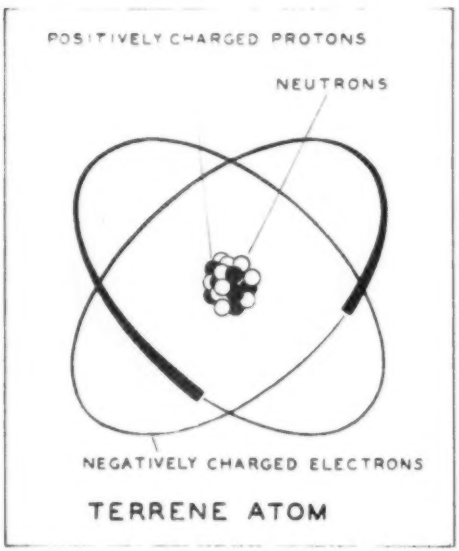
September 14, 1940, was a clear day. In the 22-foot cutter-type sailboat Rockit II on that day, three adults and a child, as reported in the New York Times of September 15, were cruising on Long Island Sound about ten o'clock in the morning. Then, suddenly, something fell out of the sky into the water, and exploded.

"The screech came first—an unholy noise, and a split second later, the explosion, about two points off the starboard bow. It blew up a great tower of water, twenty or thirty feet in the air. It was the strangest thing in the middle of that peaceful Sound. Why, there wasn't even another boat in sight, and not an airplane overhead!"

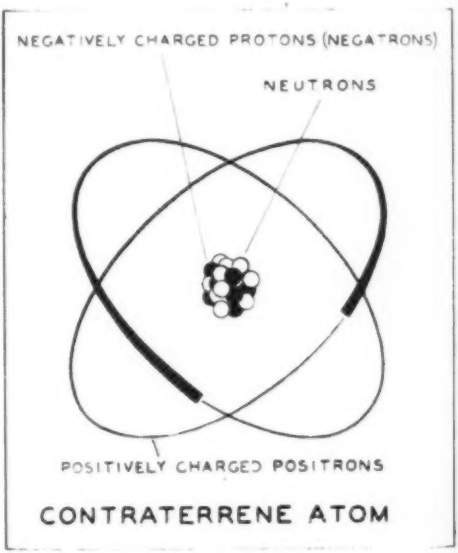
What could the thing have been? The people's first thought was that artillery practice must be going on at one of the near-by forts. Inquiry disclosed, however, that no military unit had engaged in artillery practice in that area on that day Perhaps, then, it was a meteorite. But "it was said at the Hayden Planetarium that a meteorite on striking water would not explode."

What could the thing have been, that fell out of clear space into the quiet Sound, and exploded like an artillery shell? No one can say with certainty. Aided by a hypothesis which has recently come into wide acceptance, however, scientists can now put forward a complete, though startling, explanation. This explanation is rooted in the idea that there exists a totally new kind of matter, different from any we have ever known.

Sir Arthur Eddington once said about astrophysical research that science tried to delve into the interior of a star and suddenly found itself in the interior of the atom. That remark referred to the necessity of exploring atomic structure first until it became possible to explain the composition of certain stars



Ordinary atom has Positively Charged Nucleus.



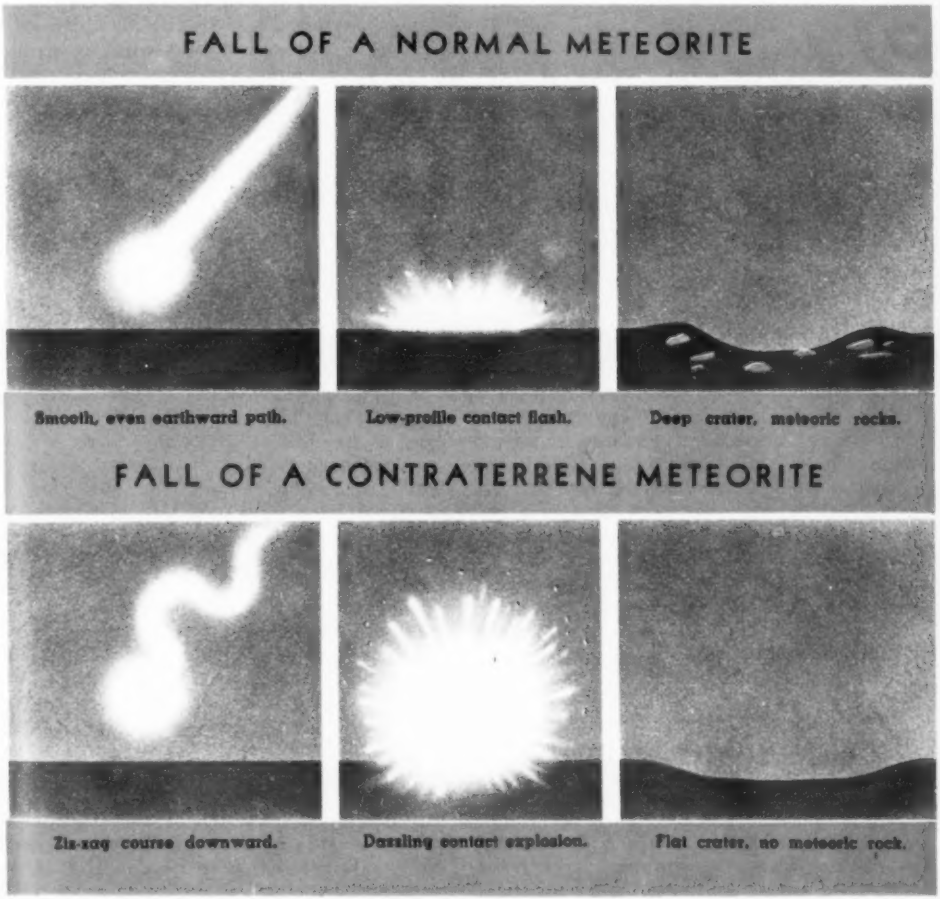
Contraterrene atom has Negatively Charged Nucleus.

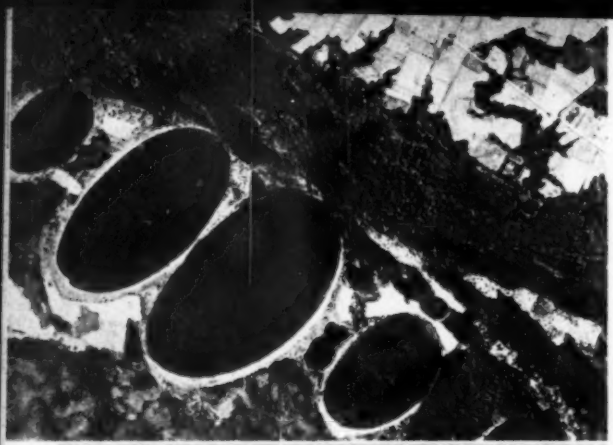
and the functioning of stars in general. It is likely that Sir Arthur's remark applies to meteorites too; before some mysteries connected with meteorites could be explained it became necessary to conceive a new type of atomic structure.

The word "atom" really means "indivisible," but our scientists have succeeded in chopping the atom up into a number of different particles. Every atom consists of a nucleus circled by one or more electrons—only one in the case of hydrogen, two in the case of helium, and so forth. These electrons are arranged in various layers or "shells." Each electron carries a negative charge and is of very small mass which is called "one." The nucleus of the atom consists of protons and neutrons, each being of about the mass 1840. The proton carries a positive electric charge; the neutron, as suggested by its name, is electrically neutral. Research has established that there is also a sub-atomic particle of mass 1 with a positive electric charge, the positron, and there is some reason to believe that there is also the neutrino, of mass 1, without any electric charge.

Thus we have three light sub-atomic particles of the mass 1—the negatively charged electron, the positively charged positron and the neutral neutrino. And we have two heavy particles, the neutral neutron and the positively charged proton. The question whether there is such a thing as a negatively charged heavy particle called, say, negatron, remains to be answered. Theoretically there is no reason to doubt its existence, but as a matter of fact the negatron has not yet been found.

Atomic theory, however, supplies a good reason for that: a negatron would be very


FALL OF A NORMAL METEORITE
Smooth, even earthward path.
Low-profile contact flash.
Deep crater, meteoric rocks.
FALL OF A CONTRATERRENE METEORITE
Zig-zag course downward.
Dazzling contact explosion.
Flat crater, no meteoric rock.



—Photo by Dr. Clyde Fisher

Looking down into Arizona's Meteor Crater. Not contraterrene-caused, this crater is deep, has meteoric rocks.

—Fairchild Aerial Surveys Photo

Oval Bays near Mullins, S. C. No meteoric fragments here. Shallow craters possibly caused by contraterrene meteors.

difficult to find because it could exist for only an infinitesimal fraction of a second under normal conditions. Like a proton, a negatron would have the tendency to form a complete atom, with other negatrons and neutrons in the nucleus and positrons instead of electrons in the surrounding shells. Given a sufficient number of negatrons, neutrons and positrons the whole series of 92 elements with all their isotopes, with decay of the heavier elements, with the same chemical reactions among one another, the same compounds and the same possibilities of alloying could be formed. It would be a complete set of elements with a complete chemistry—but it would be reversed matter, matter with positively charged "shells" and negatively charged nuclei. This theoretical set of elements has been called *contraterrene matter*, as distinct from the ordinary or *terrene* matter we know, the matter that consists of atoms with electrons revolving around positively charged nuclei.

The two types of matter, fundamentally different, mutually exclude each other. If, say, a contraterrene helium atom touched an ordinary or terrene helium atom both would be utterly and instantly annihilated. The nuclei of the two opposed types of helium atoms consist of four heavy particles each, two neutrons in each case plus two protons in terrene and two negatrons in contraterrene matter. The terrene helium atom has two electrons, the contraterrene helium atom has two positrons.

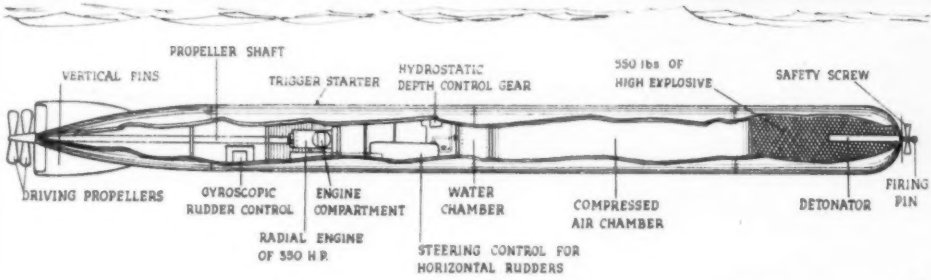
The protons and the negatrons in the nuclei and the positrons and the electrons in the shells would just destroy each other; the two atoms would both flare up into a burst of gamma radiation with eight left-over neutrons as "ash."

For this reason negatrons which might spring into existence under certain conditions would be so short-lived that they would be exceedingly difficult to detect, even if it were known where and when to look for them. By the same token a proton and a terrene atom would not last longer than the time required to destroy them in a world built of contraterrene matter. Both forms of matter are equally possible and equally stable—as long as they do not come into contact with each other. Without physical contact it would be absolutely impossible to tell which is which, for terrene and contraterrene matter would look exactly alike to the eye as well as to the telescope, the camera and the spectroscope.

That implies that we can never know whether a world that is caught in the telescope or with the photographic camera is terrene or contraterrene in its fundamental construction. This does not apply to the other planets of the solar system, for since all planets are children of the sun, and if the earth consists of proton-electron matter the other planets and the sun itself must necessarily be of the same type of matter. But we cannot be sure of Sirius or Betelgeuse and we have good reason to be doubtful about some of the comets. [*Continued on page* 158]

TEST FOR TIN FISH

THE photograph above shows a British torpedo in mid-air, propellers whizzing, as it is launched for a test run. It streaks for three rafts (left) arranged one beyond the other. As it passes below first raft an observer there drops a flag, observers at launching point clock speed with stopwatches. Same procedure follows at second raft, but underwater rope network also tells torpedo's depth. Final raft's observer is equipped with special listening device that tells exact second torpedo motor stops. Recording instruments ride in the torpedo during testing also, have indicated that some make as much as 52 knots. Diagram of a torpedo, below, shows interior construction. At right, a torpedo is recovered after its run.



WILL THE EARTH SOCK JAPAN?

by Robert Clark

The odds all favor a mighty earthquake hitting the Land of the Rising Sun even before Americans hit it!

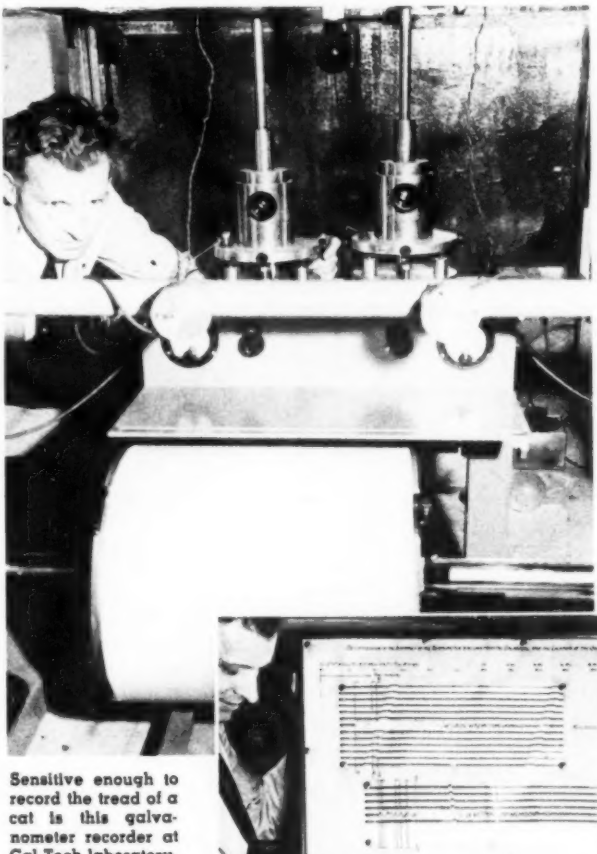
AT 11:59 a. m. on the first day of September, 1923, the sun over Tokyo moved toward noon through a serene sky. Life in the Japanese capital moved quietly in its accustomed groove and all was peaceful. Life continued to be peaceful for exactly one minute. Then the time was up!

Precisely at 12 o'clock there appeared over the city a yellow cloud—very thin at first, but growing in size every moment. This dust-cloud rose from the crumbled debris of thousands of structures, and shortly enlarged to form a continuous strip all around the bay, obscuring most of the city from view.

Five minutes passed and the proud cities of Tokyo and Yokohama were in ruins from the most destructive earthquake of modern times. Between 100,000 and 400,000 persons were killed—because of the magnitude of the disaster the exact number of dead has never been determined—and property damage reached into the thousands of millions.

Twenty years have passed since nature struck so savagely at the heart of Japan. Now, in the midst of war, is it time for the earth to strike at her again?

No one knows for sure—the science of seismology has not yet advanced far enough to predict with exactness the time and place of a future quake. But statistics on the subject tell their story. And they say most positively that a destructive earthquake in



Sensitive enough to record the tread of a cat is this galvanometer recorder at Cal Tech laboratory.

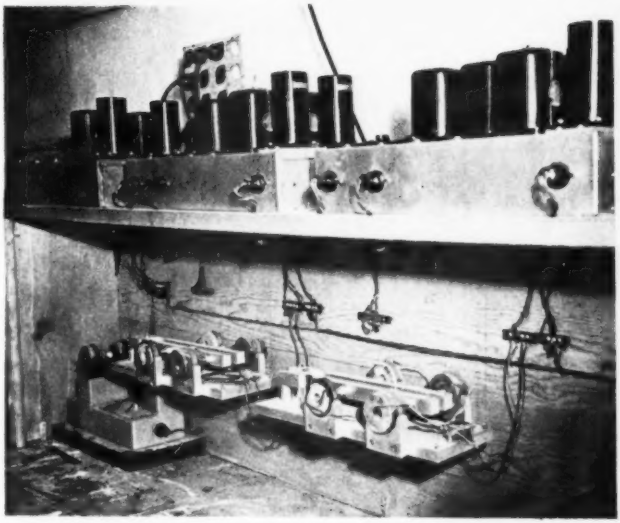
Here is the record of earth shakes made by the 'quake recorder.

Photos by Wally Milne

Japan—though not necessarily in Tokyo—during the next year or two is not only a possibility, it is a strong probability.

For Japan has about 1,500 earthquakes a year, or an average of four shocks a day. And destructive quakes occur there on an average of once in every two-and-one-half years. Their time is nearly up again.

War as an instrument of destruction is puny compared to the power of a heavy earthquake. And like an enemy submarine, an earthquake strikes without warning. Most natural phenomena that plague and fascinate man have their advance publicity agents. A drop in barometric pressure foretells a hurricane; weather reports give storm warnings; subterranean rumblings indicate that a volcano may erupt.



A big tuning fork—the kind used to sound "A"—controls frequency of oscillation in a vacuum tube circuit to keep speed of drums constant.

But an earthquake has no forerunner. Within the winking of an eye, a busy city can be transformed into a scene of unbelievable destruction and death.

No place on the earth's surface is free from shocks, although most of the severe temblors occur within regions located on what are known as the earthquake belts. There are two of these; the more prominent extends along the west coasts of South and North America, and swings over the top of the world to Japan. Fortunately for us, it is the tail-end of this belt which produces the really good shivers.

As to what makes Old Mother Nature hike up her dress and dance, no one knows exactly. Most seismologists believe that the continuous adjustment of the earth's crust to the as yet unknown processes which build mountains and elevate or depress land is the primary cause of earth tremors. It is believed to be the strain which comes from great internal shifts, which readies various portions of the earth for a quake.

But the immediate cause of a temblor may be response to some sort of trigger-mechanism. Some force outside the internal strain springs the trap and sets the crust of the earth in motion along a fault.

The effects of various external forces have been studied and many seismologists believe solar or lunar influence may be factors. Again in some regions sudden variations in barometric pressure seem to be responsible—variations as great as a pound to a square foot have occurred and over a large area such a change would represent millions of tons. Also rain, tides, and slow movements of the axis of the earth may act as trigger-forces.

But whatever the cause, the result follows a fairly regular pattern. From the source of the quake there are propagated two waves—a sound wave and a compression wave. And it is from the intensive study of these waves that the science of seismology gains its most valuable information. Because they travel at different speeds through the earth, these waves arrive at a seismological station at different times; it follows that the farther an observatory is from the scene of a quake, the longer will be the interval between their recorded arrivals. Accurate measurements of this interval gives an estimation of the distance from the station to the point of origin of the quake.

To record, study, and evaluate earth tremors there are more than 350 seismological stations in the world. Of these about 50 are located in the United States, principally on the Pacific Coast, the Mississippi Valley, and in New England. These vary from relatively simple, unattended, automatic recording stations to well-staffed and elaborately equipped laboratories.

Probably the finest in the world is located

in Pasadena, California, and is under the direction of Prof. Beno Gutenburg of the California Institute of Technology. This seismological station will no doubt be the first one to inform the Allied World if an earthquake knocks Japan for a loop again.

This West Coast observatory is truly a remarkable example of what happens when science and art fuse together and produce the maximum of efficiency with the minimum of ugliness. All too often there is only money enough to satisfy the scientific needs of a laboratory, and the aesthetic side is neglected.

But in this case one sees a handsome building nestling against a sloping hill in one of the most exclusive residential sections of Pasadena. One could easily mistake it for the palatial home of some local millionaire. Inside, however, science predominates. Nothing has been spared to give these seismologists everything they need to aid them in the study of earthquakes.

The heart of the station is at the rear of a tunnel which burrows under the hill at the back of the building. Here, beneath 20 feet of solid rock, are the station's seismometers, so sensitive they magnify earth movement as much as 100,000 times. In fact their bases have to be set on bed rock so they will not record the tilt of the building when a person walks across an upstairs room!

The principle of a seismometer is simple: It consists of two parts, a frame and a pendulum. The frame is fastened to bed rock, and the pendulum swings free. When an earthquake occurs, the frame, rock, station, everything—quivers. But the pendulum does not because of inertia—literally laziness.

The relative movement of frame and pendulum, always tiny for distant shocks, is changed into electrical energy which actuates a recording galvanometer.

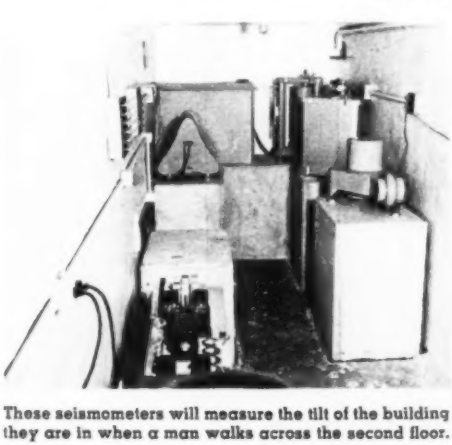
The instruments in this laboratory are probably as precise a group for measuring earth motion as can be found anywhere in the world. To one man goes much of the credit for their development, Dr. Hugo Benioff, who is active on the staff of the Pasadena station.

Because the tunnel is underground, it is ideally suited for the location of these instruments as there is practically no shift in temperature the year around. In the summer the vault seems pleasantly cool; in winter, pleasantly warm. It is an interesting fact that the heat from a person's body, if he were to remain in the tunnel for more than five minutes, would affect the galvanometers at the recording machines.

A second vault under the hill houses the large Benioff strain seismometer which measures the earth's "stretch." This rather spectacular instrument consists of two vertical pipes set 60 feet apart in bed rock. Between them, and rigidly fastened at its end to one of them, is a long rod extending nearly to the other pipe. When passage of a crustal wave occurs, there is a change in the distance between the two pipes. And the amount of this movement is transformed into electrical energy in the same manner as is done by the other types of seismometers.

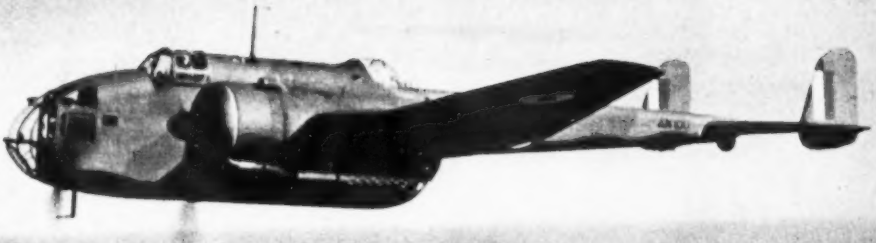
All this electrical energy, no matter from what seismometer, is conducted to a special section of the building known as the "pier room." Here is where photographic recorders connected to the many seismometers are located. These [*Continued on page* 143]

A 60-foot pipe sunk in bed rock measures the earth's "stretch" when an earthquake wave flows.

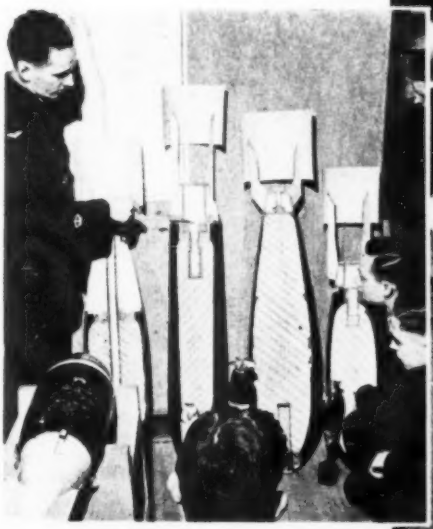


These seismometers will measure the tilt of the building they are in when a man walks across the second floor.

SCHOOL FOR SLUGGERS



BEFORE they can go out and dump high explosives on the "master race" bombardiers of the Royal Canadian Air Force must go through an intensive training. On this page are shown some of its stages. In class, *below*, cadets study bomb cross-sections, learn the special uses of each type of missile; *lower right*, they are shown the mechanisms of bomb-rack and release. The British bombsight, different from our own Norden, is shown at *right*, swinging onto a target. At *top* is a Handley-Page medium bomber, ready to blast Fortress Europe.



YOUR POST-WAR

by Donald G. Cooley

Mechanix Illustrated Art by Fred Ripperda

TWO Royal Air Force officers sat at a table in the Stork Club wining a pair of beguilingly sleek blondes. The eyes of the fliers wandered keenly around the crowded room and they breathed deeply as if absorbing enough New York night club atmosphere to last them a long time.

"Cigarette, please," requested one of the girls, and the officer with the thin dark moustache stretched his hand toward a package on the table. It stopped midway as his eyes fell on his wrist. He grinned suddenly, lifted his forearm and thrust it under the nose of his brother officer across the table.

"Look!" he invited.

The hands of his wrist watch indicated just two minutes to ten. The other R. A. F. man checked his own watch, grinned, and the pair of them nodded as if sharing a tantalizing secret.

"Let us in on it," the girl suggested.

"Didn't mean to be rude," the first officer said apologetically. "But just twenty-four hours ago we were over Berlin. And here we are tonight, doing the New York pubs with two ravin' beauties. Bit of a quick change."

It was true. The night before, the R. A. F. men had participated in a mass bombing raid on Berlin. Returning safely to their base, they found themselves entitled to forty-eight hours' leave. A ferry transport was heading west over the Atlantic and they thumbed a ride. They had a yen to accomplish some intensive New York night-clubbing, and now were zestfully accomplishing that end while Manhattan newspapers on sale outside carried headlines on the Berlin destruction. In a few hours they would be flying back to England, and before another New York nightfall might again be dropping eggs on Berlin or Duisburg or Essen.

There you have a preview of your weekend of tomorrow. Space-annihilating machinery, though now put almost entirely to military uses, is already operating on regular schedules. After the war air lines will bid

Stereo Camera at upper left will set its own shutter automatically. Your walkie-talkie (center) phones home from North Woods. Bottom, waterproof camping suit.

VACATION

Eleventh in the MI Series
"A WORLD YOU NEVER KNEW"

for your business and a two-day week end will be quite sufficient for a round-trip hop to London or Paris or Mexico City, with plenty of time to watch a bull fight or sip an aperitif on the Bois.

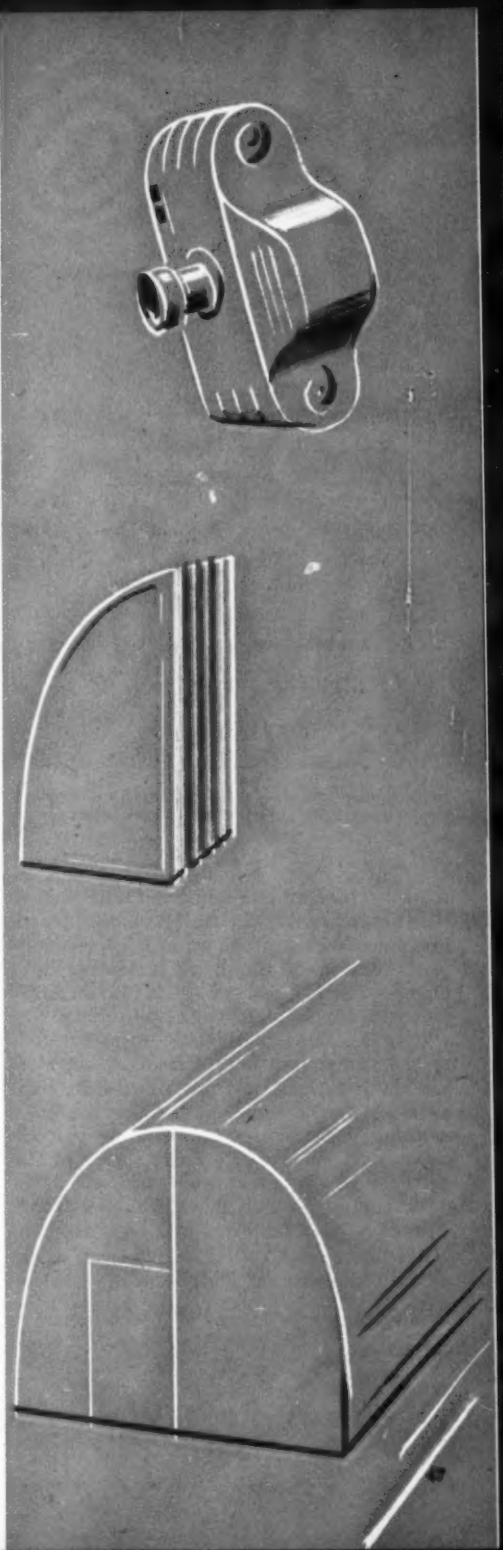
Wendell Willkie has already planned a holiday that gives us a foretaste of what we will be doing. In his book "One World" he reveals that he has made a date with President Muratov of the Yakutsk Republic for "a day's hunting" in 1945. Willkie will fly out to the republic in remote Siberia, spend a day shooting yak or bear or whatever the local fauna offers, and fly back again to resume work in his New York law office which probably will not even have missed him, if he leaves upon a week end.

Even if you stay nearer home, as many of us will prefer to, your sports, hobbies, and leisure time pursuits will be changed in thrilling new ways. And because more and more of the world's work will be done by machine, every one of us will have more leisure time to invest.

For near-by jaunts up to a thousand miles you will use your own helicopter or streamlined car. Igor Sikorsky predicts that a million of his foolproof aircraft will be in personal use within ten years after the war.

Let's start on a hunting and fishing trip of our own to some wild Canadian lake, perhaps miles from the nearest settlement. Into the helicopter or the trunk of the car we pack a few pieces of equipment that provide most of the comforts of home. If we're using the helicopter we'll land right at the campsite. The car is blocked a few miles away where the road ends, but the equipment is easily portaged by two men.

First, there's a one-room cabin, carried on our backs, of collapsible sections of light plastic materials that one man can erect into a snug little room in an hour. (The Army has such a portable hut now.) If you really want to travel light, your shelter can be a



Tomorrow's tiny movie camera, top right, will take sound movies of vacation in color. Cabin in sketches below it will fold for easy carrying on your back.

Radio sewing machine of RCA, above, welds waterproof thermoplastic cloth in stitchless, leakproof seams.

tight roll of synthetic fabric not much bigger than an umbrella. The stuff is made of plastic fibers that are tearproof, waterproof, weatherproof, extremely tough but gossamer light. Open up the roll and it unfolds into an ample tent with supports of light metal tubing.

It is the same fabric that forms the skin of the canoe that is collapsed to knapsack size on your back—no more two-man portages. It is the same, in fact, as the outer clothing you wear. Your hunting costume need not be heavy, bulky, padded, or drowned in hip boots when you wade in the duck blinds. Rather, it will be snug-fitting, with easy play for arms and legs, shedding water like a duck's back, keeping you as dry as the Congressional Record in the heaviest weather. Waterproof plastic shoes, laced around the trousers at the ankles, serve as well as rubber boots, at a tenth the weight. Nor is there any danger of leakage at the seams; these are not sewn, but welded—fused together—by a radio sewing-machine now in use on military fabrics. The cloth is not wool or cotton, but material with a plastic base that melts together, much as metal is welded, when high-frequency radio waves are shot through it. Branches can't rip the fabric and there is no possibility of its pulling apart at the seams.

There is a small can in your pack that insures you relief from that northwoods pest, the mosquito. It is a development of a high-pressure bomb originally used by Westinghouse to charge refrigerators with coolant fluids. It contains, under pressure, an insecticide harmless to man but deadly to mosquitoes—so deadly that the Army is furnishing vast numbers of these mosquito bombs to soldiers fighting in malarial country.

You stand on a swampy shore, fishing line in hand, plagued by mosquitoes in clouds as thick as Pittsburgh smoke. Out of your hip pocket comes the mosquito bomb. You touch a trigger at one end and a fine mist hisses out, vanishing in the air—but leaving an invisible curtain of death that magically wipes out every mosquito within a range of several yards. Shoot a few squirts around the tent or cabin when you go to bed and you're sure of mosquito-less slumber. Every lake cabin, every home in regions where mosquitoes, flies, and insect pests abound, can sterilize the rooms by a daily shot or two from the bomb. No more scratching or short tempers.

Lost in the wilds? Not even if you are a tenderfoot who can feel a straw with his toes through an Army boot. You carry a boiled-down version of the Army's walkie-talkie radio, small enough to sling into a canoe, to carry with you when you are going into really strange country. With it you can talk to and hear from other members of your party—across a lake to ask how they're biting, over a young mountain to learn if your partner has found game on the other side. You can describe landmarks to tell where you are, if you're

Continued

Your Post-War Vacation

lost, or tune in on a radio beam which, with the aid of a map of the section, will give you your exact position. Separated from a companion, you can talk with him on his personal wavelength and find out where he is, or ask if he has found any likely overnight camps up ahead.

"When do we eat?" is the rallying cry of all campers and picnickers, and it has some new answers. A few small packages in your knapsack give you all the perishable food you will need for two weeks or more—milk, cream, butter, eggs, meats, green vegetables. They are, of course, dehydrated, and compressed into bricks according to the most recent lend-lease technique.

Break off a chunk of brick, add water, and you have milk fresh from the cow. A piece from another brick, plus water, gives you the makings for scrambled eggs. Same with cream and cheese, with dehydrated meat that makes a tasty hamburger when reconstructed with water, with potatoes, onions, carrots, and other vegetable delicacies that the average camper must now forego. These food bricks will keep indefinitely without refrigeration, with weight and bulk cut to about one-tenth. Butter will not melt even at 120-degree temperatures. If you are fortunate enough to have ice available, you can store frozen steaks cooked by the packer—all you have to do is warm them over a campfire.

Of course you will carry a camera when camping or visiting strange lands, but the pictures you bring back will be different. Devotees claim that photography is the king hobby of them all. If so, it should attract even more fans because the need for technical skill, exposure calculation and so on is swiftly being taken out of it, as far as the amateur is concerned.

Your snapshots of tomorrow will probably be in full color instead of black and white. Astounding progress in color techniques has already been made, though much of it is still a wartime secret. It can be told, however, that one method will make use of coupled developers, astonishingly simple to use. Ingredients in the developer coupled with other chemicals in the paper give full color prints with no more complication than ordinary black and whites. Something of the sort promises to become standard drugstore finishing technique in the future. Taking of transparencies and home color movies will doubtless be similarly simplified.

Mosquito-proof tomorrow's vacation camp with high pressure insecticide bomb developed for U. S. Army.

Need for calculating exposures with split-second accuracy, of learning complicated camera mechanisms, will probably be much less. Aim, shoot, develop, enjoy the results, will be the pattern, with skill becoming a matter of composition and artistry rather than complicated knowledge about focal lengths, speed ratings and the like. Films three times as fast as the speediest of present emulsions, with vast latitude, make correct exposures as easy for the amateur as for the genius. With faster film speeds, expensive speed lenses will be less and less important; speed of cheap lenses will be greatly enhanced by the use of surface layers, only one molecule thick, that eliminate reflections and transmit all available light through the lens.

Fine-grain film is keeping pace, so that needle-sharp negatives no larger than a frame of 8-millimeter film will give projection prints of amazing brilliance [*Continued on page* 152]

A Mosquito drops its bombs at "rooftop level" on railroad shops in Namur, Belgium.

FLYING THE WORLD'S FASTEST BOMBER

by Arch Whitehouse

AT ELEVEN o'clock on the morning of last January 30, Dr. Joseph Goebbels, Reich Minister of Propaganda and Public Enlightenment, was preparing to broadcast to Germans a proclamation of their leader, Adolf Hitler. Abruptly, however, the doctor decided to postpone his speech. What changed his mind for him was a flight of British bombers, boldly timed, roaring over in broad daylight to drop bombs on Berlin. They were bombers of a type Berliners had never seen before.

But they soon saw them again. Not long afterward, on the anniversary of the founding of the Luftwaffe, Reichsmarshal Goering was about to broadcast a speech. He, too, changed his mind. Once more, timed to the minute and in full daylight, British bombers of the same type came in over the German capital to rock its buildings with high explosives. The fat marshal, huddling in an air raid shelter for an hour while listeners all

over Germany waited, had plenty of time to reflect on his earlier boasts that Germany could never be bombed.

On both of those raids the anti-aircraft fire over Berlin was heavy, and Nazi fighters came into the air to drive off the attackers. None of the bombers was heavily armed, and not one of them was armored at all. They were, in fact, built of wood. Yet of more than a hundred planes, the British lost just one! How did they do it? Those planes were protected by two things: Power and Speed. In these, Britain's Mosquito bombers bow to no other plane: They have made the Mosquito one of the outstanding planes of this war.

Recently I visited a Canadian airfield at which a De Havilland Mosquito was put through its paces for a number of American military men. I asked a Canadian official if he could give me any performance data. He shook his head.

"We can't divulge any figures," he said. "Anyway, they'd vary for the different types of mission to which the Mosquito can be accommodated. It's classed, you know, as a reconnaissance-bomber."

"I understand it can do four hundred and twenty-five miles an hour," I said.

He grinned.

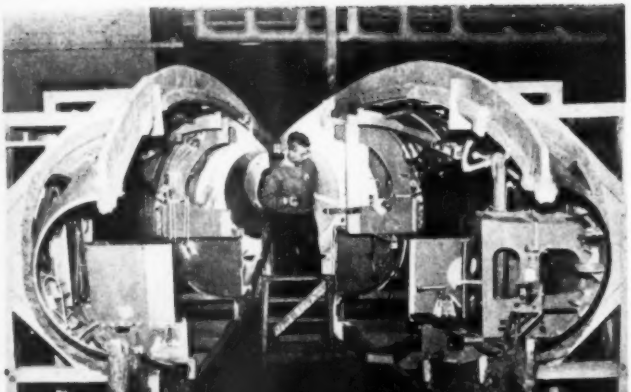
"That might be right," he said, and changed the subject.

But no matter what the Mosquito's actual speed may be, the American Army men will probably never forget the show young Geoffrey De Havilland, Jr., put on that day over the Ontario airfield. Carrying a reconnaissance military load the young test pilot did more tricks with the Mosquito than most expert fighter pilots can do with a Spitfire or a Warhawk. Slamming down from about 3,000 feet he pulled the Mosquito up "off the turf" and sent it in a vertical climb which put it clean out of sight in a cloudless winter sky, in exactly 13 seconds!

Then from a series of beautifully executed tight vertical banks, loops and lazy rolls, De Havilland brought the glistening machine down to hangar-roof height and shut off one engine. By the time he was opposite the inspection party he had full-feathered the propeller on the dead engine so that the edges of the blades knifed the slip-stream. And then he performed a series of slow rolls with

On one engine, De Havilland Mosquito streaks skyward, out of sight in 13 seconds.

Nose view of all-wood Mosquito bomber. Tiny, but one of world's deadliest planes.



Built in halves, with interior equipment installed before joining, the Mosquito is a mass-production dream. Note control wheel, right.

mathematical precision—*10 feet off the ground!*

Pulling out from this he charged after a well-known type of American bomber which was heading for the jump-off spot on the Atlantic coast; with but one engine in operation, he passed the twin-tailed aircraft as though it were suspended on the legendary sky-hooks. Then he picked out a noted Norwegian high-speed military plane which was operating out of the Island Airport outside of Toronto and literally flew sailor's knots around it.

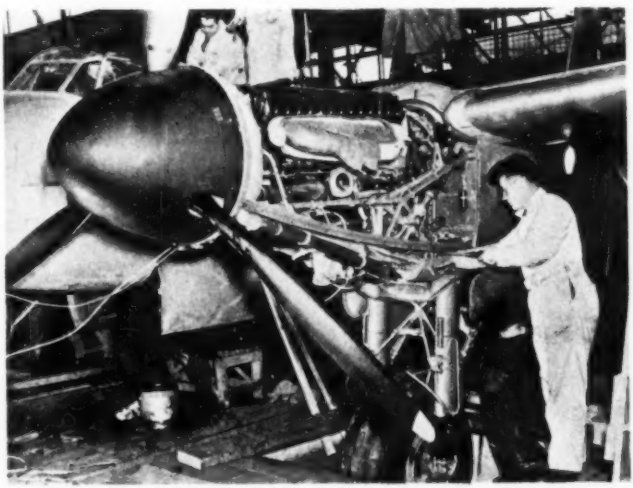
All this on one engine, remember! The average twin-engine pilot is more than satisfied not to lose operating speed when one of his motors cuts out.

Is it any wonder that more than 50 Mosquito bombers can attack Berlin in broad daylight and return with the loss of but one machine?

The De Havilland Mosquito bomber carries a crew of two—a pilot and a navigator-bombardier. Certain features of the cockpit and fuselage, however, allow a very flexible operational set-up. Though the full details of these arrangements are not available, it is understood that the Mosquito can carry four rifle-caliber machine guns or four heavy-caliber shell guns or air cannon. But on some missions, according to pilots, the Mosquito relies only on its great speed, and carries no guns at all.

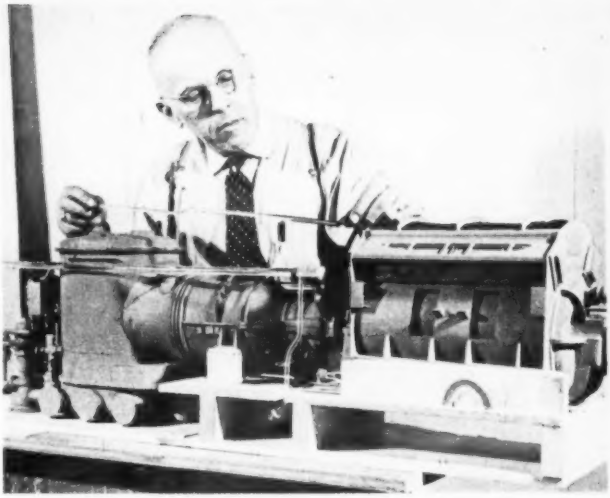
According to reports from Great Britain the Mosquito carries four 500-pound bombs, but that figure is not official. Accommodation in the two-place cockpit is comfortable and escape hatches are provided through the floor which enable the crew to bale out and avoid being struck by any portion of the tail assembly.

Though there has long been general opposition in the all-metal aircraft industry to what is loosely termed an all-wood airplane, the construction system employed in building the De Havilland Mosquito is not exactly new. So-called plastic and bonded plywood machines have been under consideration and experimentation all over the world for years. Machines involving the partial use of "compressed plywood" have been manufactured in this country for [*Continued on page* 131]

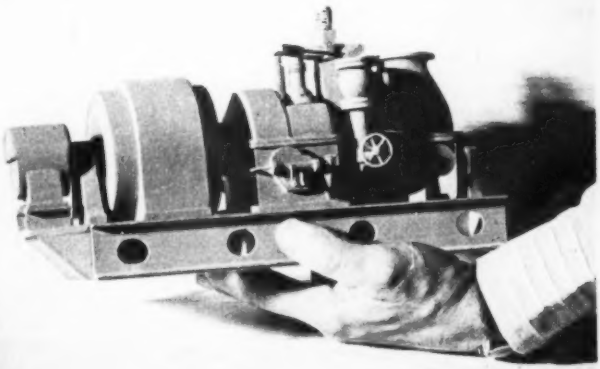


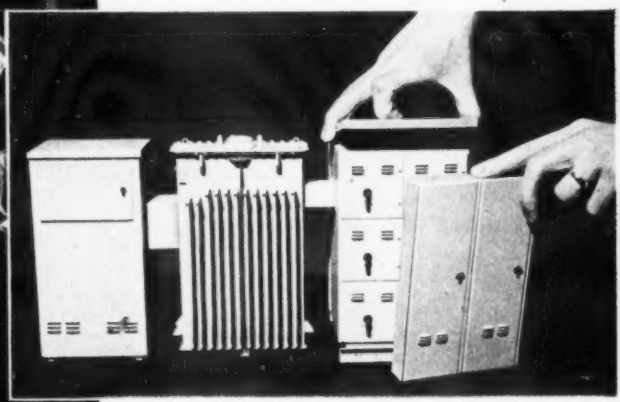
Two Rolls-Royce engines drive the Mosquito. Mysterious exhaust "flash dampeners" are visible on side of engine in above photograph.

MODEL MAN



HOWARD CHESEBRO, ace model maker for General Electric, is shown in the top photo as he adds the final touches to scale model steam-turbine generator. Hand-held model below it is of an auxiliary set for a power plant. Bottom picture shows model of a unit substation, used for demonstrating possible arrangements of standard equipment. Most of the models which Chesebro has built during the past 20 years have been used to aid in selling electrical equipment (before the war) or to speed war production by helping plant workers and engineers to visualize completed machines in advance. Below, Chesebrow removes a casting.





THE SCIENCE OF TACTICS

by Major Malcolm Wheeler-Nicholson

What are the three constant factors, and the three variable factors, which every battle commander must keep always in mind, if he is to win?

DOWN through the ages since long before the dawn of recorded history, probably no single one of man's activities has absorbed so much of his energies as war. From the earliest clan and tribal wars to present-day battles between entire continents, man has sought to perfect himself in group fighting technique. To this end he has steadily evolved new weapons, each one an improvement over its predecessor, from rocks and clubs to the latest automatically directed and fired anti-aircraft gun.

In doing this, he has devoted himself principally to improvements in tactics, the art of winning battles, rather than to strategy, which is the art of winning wars. But wars are won by winning battles, and the winning of battles was of paramount necessity long before strategy assumed its present importance. For in the earliest days most wars were decided by a single battle.

All battles, the most ancient and the most recent alike, are decided by the interplay of three factors—firepower, shock and mobility. The first warring cavemen supplied the firepower with rocks, thrown by hand or in slings. Their knotted clubs provided the shock action. Their mobility was a matter of rushing at the enemy in a loose mob, on foot.

Firepower is a constant factor in battle tactics, whether the missiles be heaved in the form of rocks or arrows, machine-gun bullets or 155-mm. high explosive shells. Shock is a constant factor, whether it be the knotty club in the hairy hand of the caveman, the charge of the mailed cavalry of medieval days, the heave and lunge of bayonet in the hands of the infantryman or today's onset of huge tanks.

Mobility is the same, whether provided by the bare legs of the caveman, the legs of horses, the treads of tracked tanks or the wings of air transports.

In addition to these three constant factors in battle tactics, there are three variable factors. These are the changing roles and varying capabilities of the three basic battle arms—infantry, cavalry and artillery. The history of tactics is the story of how each of these arms by turns has won temporary ascendancy over the others because of the increased firepower, shock or mobility given it by some new weapon, only to be superseded again by another turn of invention's wheel.

The earliest and most primitive battles were infantry encounters—mobs of footmen who rushed at each other in loose formation and strove for mastery in individual combat, until one side or the other was defeated. A slightly less primitive stage was reached in the first battles of recorded history, when the headman, chief or king, rode into battle on horseback or in chariot, surrounded by his followers on foot. The battles of the Egyptians, the Hittites and the Greeks at the siege of Troy, were fought in this fashion, mainly with the leaders in chariots, for the use of chariots preceded the use of horses as mounts in battle.

As disorganized and as loose as these formations were, they represented the first attempt to fight battles by the concerted action of groups instead of individual men and can be said to be the foundation of tactical action in battle. The chief wielded bow and spear from his fighting platform while his followers, who were bowmen, slingers and spearmen fought around him as the rallying point. Little science was used in tactical dispositions. The first recorded mention of attacking the enemy front and flank came from one of the inscriptions of Sennacherib, king of the Assyrians, around 700 B. C. The Assyrians were bold and resourceful big game hunters and they followed the procedure natural with hunters, who would maneuver to envelop their quarry. It was a natural transition to apply these first rudimentary tactics against human opponents.

With the Assyrians, the chariot began to decline and cavalry began to make its appearance in the form of horse bowmen. The foot-

men made up the bulk of the forces, however, being mainly archers, with some slingers attached. They were divided into light and heavily armed, the latter carrying shield and helmet. But these troops were mixed, horsemen, footmen, archers and slingers all hurrying into battle pell-mell without much attempt to achieve order in their ranks.

Cyaxares, the Median King, who was at first defeated by the Assyrians, studied the reasons for his failure and evolved a successful answer. It was he who first divided the troops of Asia according to arms, and organized them into separate companies, spearmen, and archers and horsemen.

At about this time occurred the first recorded examples of artillery—rude ballistae used in sieges of wall towns.

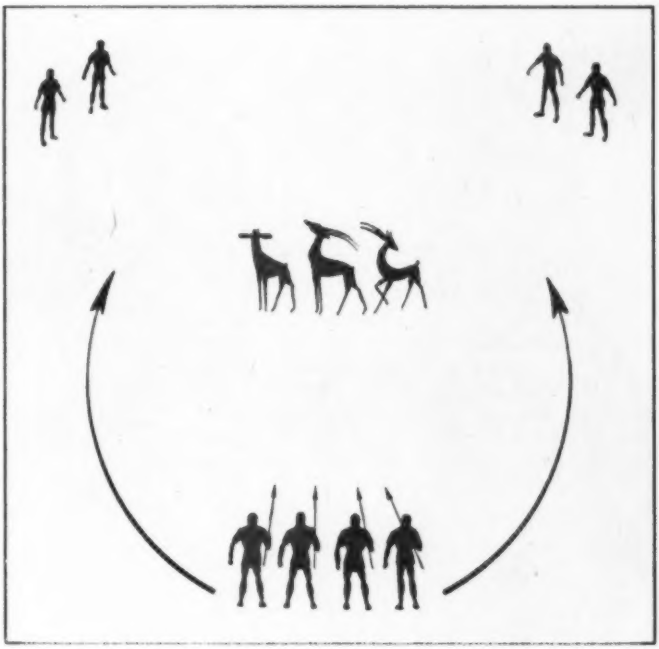
Cyrus, the leader of the Persians, adopted the Median organization and tactics, such as they were, and they remained practically unchanged down to the time Darius encountered Alexander so disastrously. The Persian infantry used firepower as its main mode of action; the infantry, holding the center, cast javelins at the foe, while the cavalry, on the wings, used their mobility and shock power against the enemy flanks. Such methods were effective against an undisciplined foe but were useless against well disciplined infantry.

The Greeks were first to develop this latter. One of their earliest commanders was Miltiades, a native of the then Thracian Chersonese, the modern Gallipoli, who fought for Athens at Marathon. The Greeks developed heavily armed infantrymen, called *hoplites*, who were pikemen. They attacked in phalanx formation, eight ranks in depth. The firepower of the Greek phalanx was zero but its charge was almost irresistible, and its defense well nigh impregnable. The phalanx was like an ax with the pikes as its cutting edge. But it lacked flexibility and maneuverability and was weak agains flank attacks.

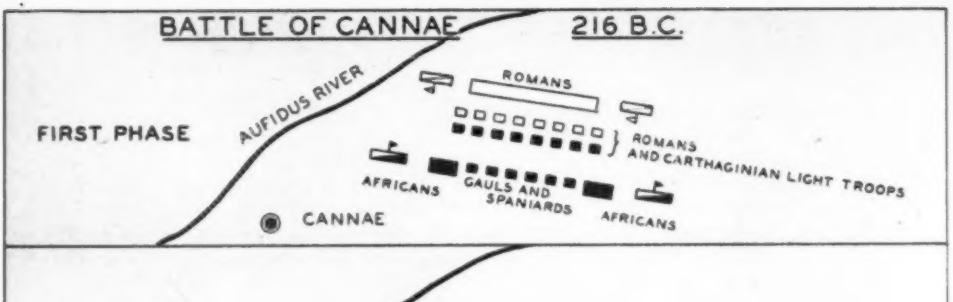
It was however, far superior to the Persians at Marathon and on other encounters, notably at Plataea, where the inexorable charge of the phalanx broke and scattered the Persian infantry. The tendency of the phalanx line was to drift to the right—the shield being on the left arm of the hoplite. In battles of phalanx against phalanx this resulted in the right wing of each defeating the left wing of the other, thus leaving the two right wings to fight it out alone with the battle finally decided by the relative position and condition of the surviving right wings.

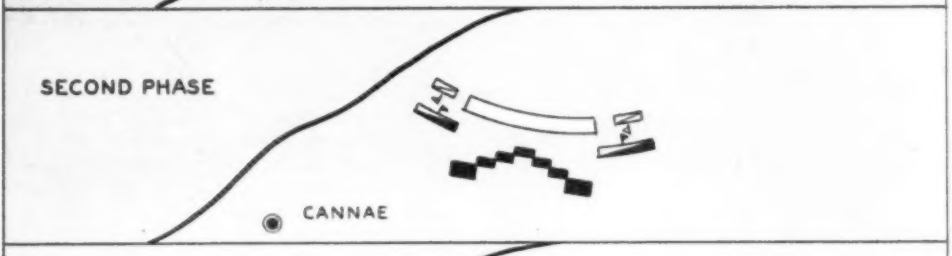
The Spartan phalanx had as battalion unit, the *mora*, of some 400 men, subdivided into four companies called *lochoi* of 100 men each. The captain was called *lochagos*, the same title borne by captains in the Greek Army today. These companies were further divided into platoons and sections. But the Spartan phalanx was at last defeated by a keen Theban soldier, named Epaminondas, who had studied the tendency of the phalanx to drift to the right and set about taking advantage of the weaknesses of phalangial formations.

At the battle of Leuctra, one of the most important battles of the world in its influence on tactics, he faced the Spartan line with a line of solid columns, making his left, instead of his right wing the strongest, and "refusing," or



Tactics originated in hunting, when cavemen blitzed game.





The battle of Cannae, in which Hannibal smashed a Roman Army, is still regarded by military men as a masterly example of tactical skill, was the basis for German Schlieffen plan of attack on France.

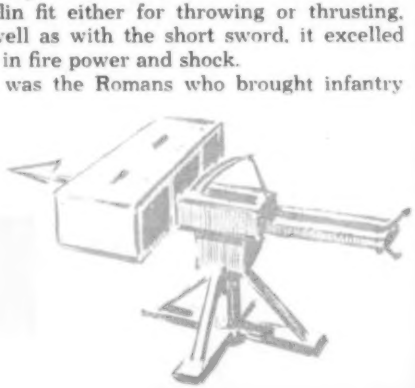
echeloning each of the center and right columns. As a consequence the unexpectedly strong Theban left struck and ground into the Spartan right, while each remaining Theban unit moved forward successively and rolled back the weaker Spartan left, until the Spartans were driven from the field.

The Theban phalanx was brought to its highest development by Philip of Macedon, who deepened and strengthened it and provided the hoplites with long pikes, known as *sarissa*, some of them 24 feet in length, which made a bristling and impregnable mass of the Macedonian phalanx. But Philip's main contribution to tactics was his development of cavalry, increasing its training, discipline, mobility and its shock power. Alexander, his famous son, developed the flexibility of his entire army through the solidity and independence of each unit—a great advance in tactical progress and the first time that this had been done.

Alexander carried the art of tactics to the highest point then known, and was the last and greatest of the ancient commanders who himself acted as supreme head and as commander of fighting units on the actual field of battle.

Under Alexander, cavalry rose to a near equality with infantry, being possessed of high mobility, and armed with the Macedonian javelin fit either for throwing or thrusting, as well as with the short sword, it excelled also in fire power and shock.

It was the Romans who brought infantry



Continued

The Science of Tactics

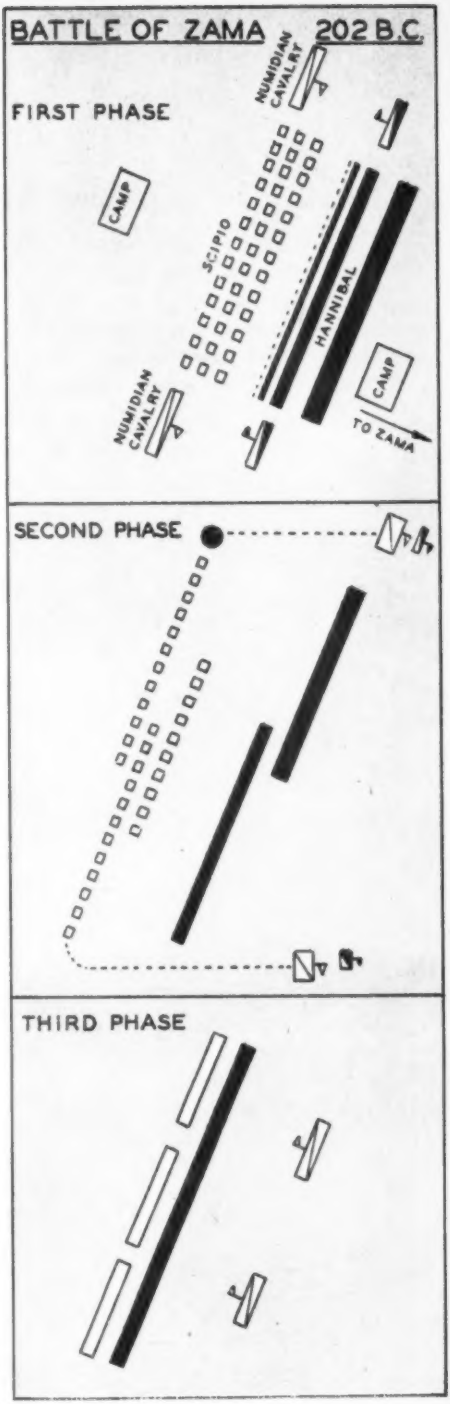
to its highest development in the ancient world.

From the time of the founding of Rome to the defeat of the Roman legions of the Eastern Empire by the Seljukian Turks in 1071 A. D. at the battle of Manzikert, the Roman Army carried out an unbroken military tradition for 18 centuries! The strength of the Roman arms had as foundation the organization of the Roman legion. Consisting of some 3,000 men in the early days, its fighting formation combined a high degree of mobility, shock and fire power, principally because of the flexibility and maneuverability of its line of small groups. These were the 30 maniples into which the legion was subdivided.

Instead of having a solid line of shields and pikes as in the phalanx, the first line of the legion, called the *hastati*, its ranks filled by the younger and more daring soldiers, consisted of some ten companies or maniples of 100 men each, six deep, in approach formation. They advanced on the enemy at a run for the last hundred feet, hurling the Roman javelin, the *pilum*, in a shower of missiles. Under cover of the confusion caused by this assault with fire power, the *hastati* spread out and began to hack into the foe with the deadly Roman short sword, which is a classic example of the axiom that the shorter the weapon the greater its offensive power.

Behind the line of these battling *hastati* was a second line of companies also six deep, the *principes*, composed of older, steadier and more experienced soldiers, armed with sword and pike. Their task was to continue the forward impulsion, replace the fallen and steady and support the first line. Behind these was the third line of companies, the *triarii*, composed of the oldest men of the legion. These constituted the first use of the reserve, so that it became a Roman military axiom that the commander who was last to throw in his *triarii* generally ended up as victor on the field of battle.

The Roman legion sustained defeats but generally they were due to the inexperience or lack of skill of individual consuls, the commanding generals. One of the greatest of these defeats was that administered by Hannibal at the battle of Cannae. In this battle Hannibal used the concentric attack for the first time, an innovation that had a profound influence on tactics [*Continued on page* 160]



In the Battle of Zama Scipio Africanus extended his lines to prevent envelopment, defeated the Carthaginian Hannibal to avenge the Romans' rout at Cannae.

THE MAN WHO STAYED

by George Daniels

The second of two articles about John Hays Hammond, Jr.—yachtsman, executive, traveler, son of a world-famous mining engineer, holder of more than 700 patents—whose admiration for the advantages of laziness is equalled only by his own abounding inventive energy

EVEN John Hays Hammond, Esq., probably never dreamed what an important part his son, Jack, was going to play in world events. But as it turned out, this youngster, some years later, originated the plan for aerial coastal patrol which was promoted by the Aero Club of America during World War I and is being used by all the powers in the present war. Indirectly, we can thank him for the Axis submarines that now lie shattered on the ocean bottom as a result of observation work by the planes and blimps of our military forces.

Others of his contributions to America's military might date back to that first World War. It was at that time that his development of the basic principles of the now common super-heterodyne took place. The Germans had learned the trick of jamming the air waves, and as radio was then in its infancy, this jamming technique was not difficult. Receivers were not very selective, so Kaiser Bill's technicians had little trouble filling every available channel with unintelligible crackles and sputters and anything else that would garble Allied communications.

At the time that the U. S. Army Signal Corps took a few samples of inventor Hammond's super-selective sets to France, the boys from Berlin were really making the ether a pretty useless medium. It was not surprising that Allied radio officials were elated when Jack Hammond's little sets picked clear signals from the air despite all the interference the Germans could set up. They were more than three times as selective as any other sets then in existence.

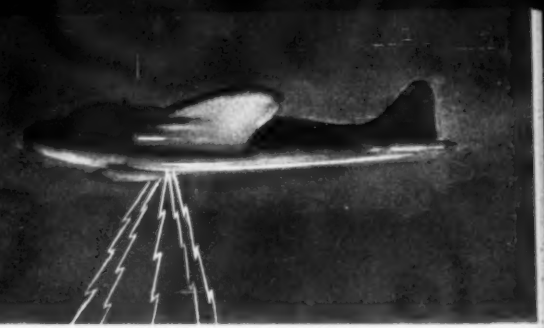
Not the man to rest on his laurels, Hammond went on with his work, endeavoring to develop a secret radio signal that could not be intercepted by the enemy. In 1922, he hit on a type of radio transmission that we think of today as the most modern thing in electronics. In general terms, it might be called "radio in reverse." Remarkable in that it permits clear, uninterrupted transmission and reception during even the most violent thunderstorm or electrical disturbance, this sensational system has a new name in the present day. Technically known as "frequency-modulation," its modern nickname is FM!

Occasionally Hammond turns out an invention that does such astonishing things that it arouses his sense of humor—and he doesn't mind sharing a laugh or two about it. One such device is an aircraft instrument designed to make civilian and commercial flying safer after the war.

Mounted in your family

Jack Hammond, Jr., and "Pirafon," volume-controlled piano.

IN BED
PART II



plane or helicopter, it just simply won't let you take part in a collision of any sort. It operates in a similar manner to the device in Britain's present-day night fighters, and when applied to the flivver ships of tomorrow it will render careless fliers harmless even if they are sound asleep at the controls.

If, for example, you doze a bit as you fly home from a late party, and a stream of cross-country express planes happens to cross your path, this intelligent instrument will probably awaken you with a bong and some flashing lights on the dash panel.

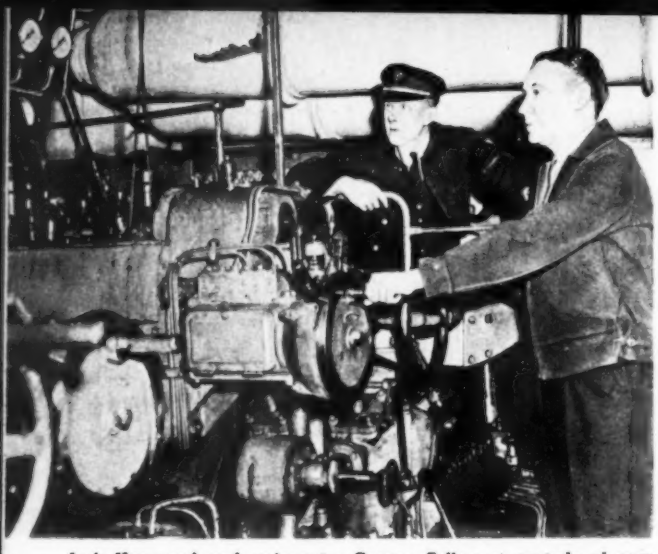
Or if you prefer a more courteous manner on the part of your aircraft instruments, it may make use of a loudspeaker in the ship's cabin, to announce. "Pardon me, pilot, but there seems to be something in our way—hold on tightly, please!"

If you persist in giving a deaf ear to its pleadings it will take control of your ship itself, and see you safely home. This is no mere prediction, as Jack Hammond doesn't make predictions. He tells of his inventions only after they have been successful in one form or another, or when all their components have been satisfactorily tested.

"If I were to predict a radio that would bring you a news program when you press a button marked 'news'—or a concert when you press another button with the label 'classical music,' I might be called a crack pot," Inventor Hammond told us. "But we have already developed such a radio in the laboratory, so I can safely say it is possible."

Inventor Hammond explained that the need for such a radio first occurred to him during

Artist's version of Hammond radio-controlled dive bombers in action. After raid they escort master ship.



Jack Hammond and co-inventor George Colley at controls of new automatic variable-pitch ship propeller. More speed for U. S. boats.

disconcerting interludes in which someone kept "fishing" for a program of the desired type. Bombastic commentators were chopped off in the middle of a sentence, followed by a few bars of a Strauss waltz, and perhaps a flourishing assertion that somebody's liver pills make you feel fine.

With the new Hammond type of program selection, things like that can't happen. If you push a button for dance music and there is no dance music being broadcast, the set will wait until there is some before anything issues from its speaker. If you think you'd prefer the music over a particular station, you push the music button and the station button too. The set will then wait patiently until that station has a program of music, and it won't make a sound until then, unless you change its mind with its buttons.

One of the revealable developments in Hammond's radio work is a radio-controlled dive bomber, much of the mechanism of which is covered by issued patents. Though its details cannot be described at present, the deadly nature of its action can be told.

Flying singly or in squadrons, these amazing pilotless ships are to be manned by machine only, and guided by master ships thousands of feet above them, well out of range of anti-aircraft fire. Diving at lightning speed, to point blank range, the aim of these meteor-like ships cannot be disturbed by the human factors of fear and nerves. No human instinct of self preservation can make them hesitate for even a split second before diving into a hail of pom-pom fire. And although the enemy may score a dozen hits, their bomb load will still find its mark.

Perfectly adapted to the modern technique of skip-bombing, these flying automatons may easily be directed along a mast-high course by a pilot who handles their controls from a bomber, miles overhead. They can attack an enemy ship or convoy from all angles, while the master ships above add havoc with their own bombs.

When the raid is completed, the master ships can bring their radio-controlled dive bombers up to their own altitude to act as escorts. If enemy pursuit pilots care to venture an attack, they will face adversaries that fight not only with machine guns, cannon and bombs, but also with collisions—for they have no one aboard.

In addition to inventing for both business and pleasure, Hammond has another interesting, and probably unique, hobby. He collects ancient facades, or house fronts. The patio of his castle at Gloucester is decorated with facades, front doors and all, imported from many parts of the world—collected during Hammond's travels.

Where the castle's rolling lawn meets the water's edge, Inventor Hammond has had a beautiful burial vault built—for himself. He doesn't plan to use it for quite a while, but he feels that it's a better-than-average spot to be buried. "I like the locality," he remarked, "and then, too, if one must be buried, why be buried among strangers?"

Meanwhile, however, Jack Hammond's abundant energy continues to dart down new paths of inventive conquest, keeping his telephone wires always hot, and his Patent Attorney, N. L. Leek of New York, in a state of virtually perpetual motion. His latest patent is an automatic variable-pitch propeller for ships, which keeps a constant electrical check on itself to insure continuous operation at peak efficiency, adjusting itself according to varying conditions of water, speed and load.

Jack Hammond may think that "The Man Who Stayed in Bed" has interesting possibilities as a fiction theme. But he doesn't do it himself.

NEW WPB ORDER MAY ENTITLE YOU TO WORLD'S FINEST ANTI-FREEZE

The War Production Board, by its recent Limitation Order, has prohibited the sale of "Prestone" anti-freeze for use in passenger cars, station wagons and taxis. The purpose of the order is to free for more essential uses the supply of ethylene glycol base anti-freeze left over by the armed forces.

IF YOU'RE ELIGIBLE—GET YOURS NOW

War supply hazards being what they are, the prudent operator will lay in his next winter's supply of "Prestone" anti-freeze *right now, this summer.* This is the one way you can be absolutely sure of having an adequate supply when the cold weather starts.

IF YOU OWN A DELIVERY

truck or service fleet, the order makes you eligible for the all-winter protection of "Prestone" anti-freeze. Put it in and stop worrying about winter breakdowns and the shortage of replacement parts.

IF YOU OWN A BUS . . .

"Prestone" anti-freeze can help you keep war workers on a war schedule. Special ingredients in "Prestone" anti-freeze protect against rust, corrosion—a protection against parts replacement.

IF YOU OWN A TRACTOR

working either for industry or for America's vast farming program, you can insure it against winter with "Prestone" anti-freeze. The same applies to stationary engines and all construction equipment.

IF YOU OWN A TRUCK,

you are eligible for "Prestone" anti-freeze to keep essential wheels moving. No need to idle your engine during winter stops to avoid freeze-up—"Prestone" anti-freeze saves you precious gasoline!

SAME PRODUCT AS ALWAYS

ONE SHOT LASTS ALL WINTER
YOU'RE SAFE AND YOU KNOW IT!

PROTECTS AGAINST RUST AND CORROSION!

It can't evaporate or boil away!

It creates no fire hazard!

PRESTONE ANTI-FREEZE

TRADE MARK

The words "Eveready" and "Prestone" are registered trade marks of National Carbon Company, Inc.

Unit of Union Carbide and Carbon Corporation

UCC

The Winners!

TOP CONTESTANTS IN THE GREAT MI "BUILDWORDS" GAME

HERE are the winners in MI's great "Buildwords" Contest:

1. Gordon Chock, Box 1096, East Ely, Nevada. Aeronca Defender Trainer or $1,500 in War Bonds.
2. Frank Duncan, 27 Calhoun Avenue, New Rochelle, N. Y. Hamilton Wrist Watch.
3. T. F. Leary, 42 Summit Street, Burlington, Vt. Hallicrafters Sky Champion Radio.
4. Frank Mathews, 744 Clinton Street, Brooklyn, N. Y. Whizzer Bicycle Motor.
5. Florence Gray, 54 Mapes Avenue, Nutley, N. J. Atlas Drill Press.
6. Maurice Marsh, Jr., Jeffersonville, Vt. ZEPHYRPLANE JR. Belt Sander.
7. James J. Moughan, 211 South 10th Street, Council Bluffs, Iowa Keystone Movie Camera.
8. Helen LeMoine, [*Continued on page* 154]

MI's "BUILDWORDS" Contest is completed. The winner of the wonderful Aeronca plane is Gordon Chock, of East Ely, Nevada. Winners of the other prizes, including the $195 Hamilton watch and the Hallicrafters Sky Champion Radio, are listed in the column at the left.

Entries in this contest were approximately 10,000 more than the Editors had expected, and altogether the contest was the greatest possible success.

This year, the judges attempted to make the contest rules as liberal as possible. The rules read, "Words appearing anywhere in this dictionary (Webster's New International Dictionary, Second Edition) will be acceptable." One or two exceptions were noted. Mr. Chock displayed almost unbeliveable ingenuity in finding words with high score values in the [*Continued on page* 156]

RADIO FACTS—FOR YOUR *FUTURE*

Radios in 28,700,000 homes and 6,800,000 cars must be kept operating.

Radio-trained men get interesting assignments, higher ratings and more pay.

Television, now perfected, will be a boom industry requiring many experts.

Get into RADIO now!

YOU'LL BE IN BIG DEMAND FOR YOUR SERVICES!

Here is part of a typical help-wanted advertisement which appeared recently: "ELECTRONICS ENGINEERS, LABORATORY ASSISTANTS, PRODUCTION MEN—Well Paying War Job Plus Peacetime Career! Ideal working conditions with expanding manufacturers now at war work and planning peacetime developments. Unlimited opportunity for an important place in a New World of Radio."

FREE TRIAL LESSON PROVES YOU CAN LEARN QUICKLY

Train Your Brain —and let it work for you!

National Schools' Radio Training puts you on top!

YOU GET HOME TRAINING from a real, established Trade School

For 38 years National Schools has trained ambitious men for Top Pay Trades in Los Angeles. The same technique, the identical shop methods that are so successful in training Radio men at the School, are now available to you by National's Plan of Home training. You are assigned a progressive series of instructive lessons and you learn step-by-step. It's the Shop-Method Training Plan, developed for men who want practical, easy-to-grasp instruction in Radio.

TRAIN FOR FULL RICH REWARDS in these Jobs

Radio Expert
Broadcasting
Aircraft—Marine
Indust. Electronics
Studio Technician
Gov't Service
Remanufacture

YOU CAN BE A SUCCESS IN THE GIANT RADIO INDUSTRY

You learn how to build, repair and service Radios, learn fundamentals of Broadcasting, basic elements of Electronics; you acquire the ability to professionally handle all types of radio equipment.

EARN WHILE YOU LEARN

You can keep your present job and learn RADIO in all its fascinating branches without further delay. National Schools of Los Angeles has provided an amazing method of training which brings instruction to you right in your home. Many men in Military service have enrolled and continue their training in service.

FULL DETAILS FOR A PENNY POSTAL

Act Now. You'll be amazed when you receive our Free Trial Lesson, Opportunity Book and full details. No obligation; no cost. Investigate.

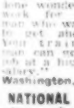
MEN IN SERVICE
Many men in Military Service have enrolled.

NATIONAL GRADUATES WIN GOOD POSITIONS

"National Schools has done wonderful work for the man who wants to get ahead. Your trained men can get a job at a higher salary."
Washington, D. C., O. K. Ivey

NATIONAL TRAINING PAYS

"Your schooling helped me obtain a swell job. Now, in the navy, I am following the profession I learned at National. It will help my chances for rapid advancement."
H. Schroeder, U. S. Navy



2 BOOKS FREE

REQUEST FULL DETAILS

DID YOU KNOW?

The Radio industry is part of the Electronics group of over 10,000 establishments which design, manufacture, purchase and sell a BILLION dollars' worth of equipment annually.

Radio-trained technicians are needed in all these lucrative, high-pay fields: Radio and Broadcasting Industry, the Sound Picture and Public Address Business, Communication by Radio, Wireless and Wire, Facsimile Reproduction, Television, and in many industrial plants.

After the War, many new secret devices employing the electron tube will be revealed to the Public and will have great money-making possibilities.

Today, the electron tube is performing miracles in industry: control and conversion of power; control of chemical, mechanical and electrical processes; and hundreds of other amazing applications. National instructors keep abreast of all these developments in order to prepare you **today** for the future.

It's a BIG FIELD and it's smart to plan NOW to train yourself to reap the rewards that will come after the war to the National Schools' Trained Radio Technician.

NATIONAL SCHOOLS

Los Angeles California
ESTABLISHED 1905

MAIL FOR FREE LESSON & BOOK

National Schools, Dept. MI-8
4000 So. Figueroa, Los Angeles—37, Calif. (Paste on a Penny Postal)

Mail me FREE, without obligation, Trial Lesson and Opportunity Book, with full details about RADIO Training at home.

NAME ..... Age .....

ADDRESS .....

CITY ..... STATE .....

BRINGING THE WAR TO YOUR LIVINGROOM

Cecil Carnes, left, just after a hair-raising glider school broadcast.

by Paul R. Milton

RECENTLY on the March of Time radio show, Westbrook van Voorhis, "Voice" of the program, said:

"Before our microphone in Chungking, China, stands General Claire L. Chennault, commander of the Flying Tigers, waiting to tell you how he and his men are downing Japanese planes. We take you now to Chungking, China. . . ." At that moment the following things happened:

In the master control room of the National Broadcasting Company in Radio City, an engineer flipped a switch, shifting the channel over which the program was flowing to a telephone line running to San Francisco, where a shortwave receiver tuned to Chungking's shortwave sender was picking up General Chennault's opening words, spoken in a broadcasting studio in the rubble-strewn Chinese war capital.

Behind that seemingly simple, almost casual act lay the co-operating action of a broadcasting network centering in the master control room with telephone engineers, radio technicians and a production staff, all operating on split-second schedules.

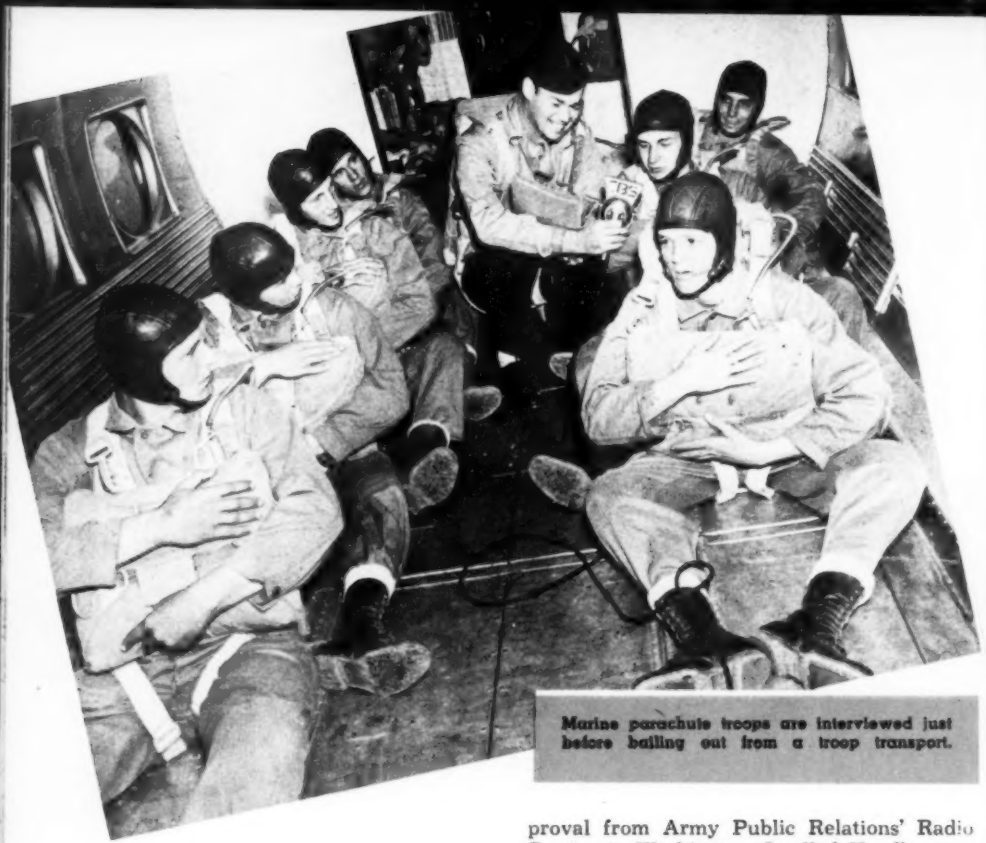
In the case of this Chunking cut-in, as with some others, an additional problem existed, that of timing in the New York studio of origin, in the switchover and at the point of pick-up. On all longwave and some shortwave cut-ins, it is possible for those at the point of cut-in to "monitor" the preceding part of the program —that is, hear it via headphones—to listen for their cue. Monitoring is usually done by means of a separate telephone or shortwave channel. But with Chungking and some other extremely distant points, extra channels are too difficult to clear. Therefore the broadcaster at the far end is given an exact time to start talking, say 10:43:30 translated into Chungking time. Thus the preceding part of the program —orchestral and announcement introduction, previous speaker (maybe a verbose politician from Washington) must be finished not only by 10:43:30, but so exactly that there is neither overlap nor falling short. While every radio program is closely timed, there is usually some slight latitude or "spread," to allow for speakers' speeding up or slowing down. But timing for a "blind" cut-in calls for extra vigilance. A slip of five seconds may spell hopeless confusion.

That particular broadcast of General Chennault's had to be cut off after some thirty or forty seconds because static over the Pacific rendered his words almost unintelligible. At a signal from the producer, the channel was switched back to the main studio and Van Voorhis said: "Ladies and gentlemen, we regret that owing to difficulties of reception, we are unable to complete General Chennault's broadcast tonight." It was believed that natural static—electric storms—had been the trouble. But some days later the following cable reached Time Magazine from its reporter in Chungking, Ted White:

"Chungking informed General Chennault's broadcast to Americas not received due to interference from another station. All here believe

Maj. Gen. Andrew D. Bruce, between two men in jeep, studies his script for a broadcast from the field.

Tanks roll forward on cue for broadcast describing Armored Force.



Marine parachute troops are interviewed just before bailing out from a troop transport.

interference was due to Japanese jamming since they probably monitored messages arranging pickup. This is probably the only time the Japanese scored a victory over Chennault in the air."

Such is a typical hazard of radio engaged in bringing the war to your livingroom—the first war in history to be radio-reported.

Recently I was assigned to set up a broadcast from Camp Hood, Texas, the training center of the Tank Destroyers. I'll describe the development in some detail to illustrate not only the problems of the actual broadcast itself, but the pre-broadcast planning and preparation as well.

We scheduled the spot for the regular program on Thursday at ten-thirty p.m., E.W.T. The preceding Monday, after obtaining approval from Army Public Relations' Radio Section in Washington, I called Hood's commanding officer, Major General Andrew D. Bruce, at his headquarters, explained our intention, got his consent and told him I would arrive the next afternoon. That night I enplaned from LaGuardia Field for Dallas, arrived the next morning, took train three hours to Killeen, whence the General's car carried me the remaining thirty miles to the post—about eighteen hundred miles in nineteen hours with little or no sleep.

While I was en route, the New York office, working through NBC, ordered a special telephone line to be installed at Hood; and arranged for an engineer and a producer to join me from Chicago's NBC studios, and an announcer from NBC's outlet station in Dallas. They would arrive Thursday, the day of the broadcast.

Continued

Bringing The War To Your Livingroom

Upon arriving at Hood my first task, in a conference with General Bruce, was to organize the subject matter of the broadcast. In the presence of his staff officers the General told me:

"We are here to give you everything you need to make the broadcast a success—men, vehicles, weapons, time, information and advice. We're grateful for this chance to tell the American people what we're doing, and how we're doing it, with their sons, husbands, fathers and brothers. Besides, we feel we owe such reports to the American people. They're our bosses."

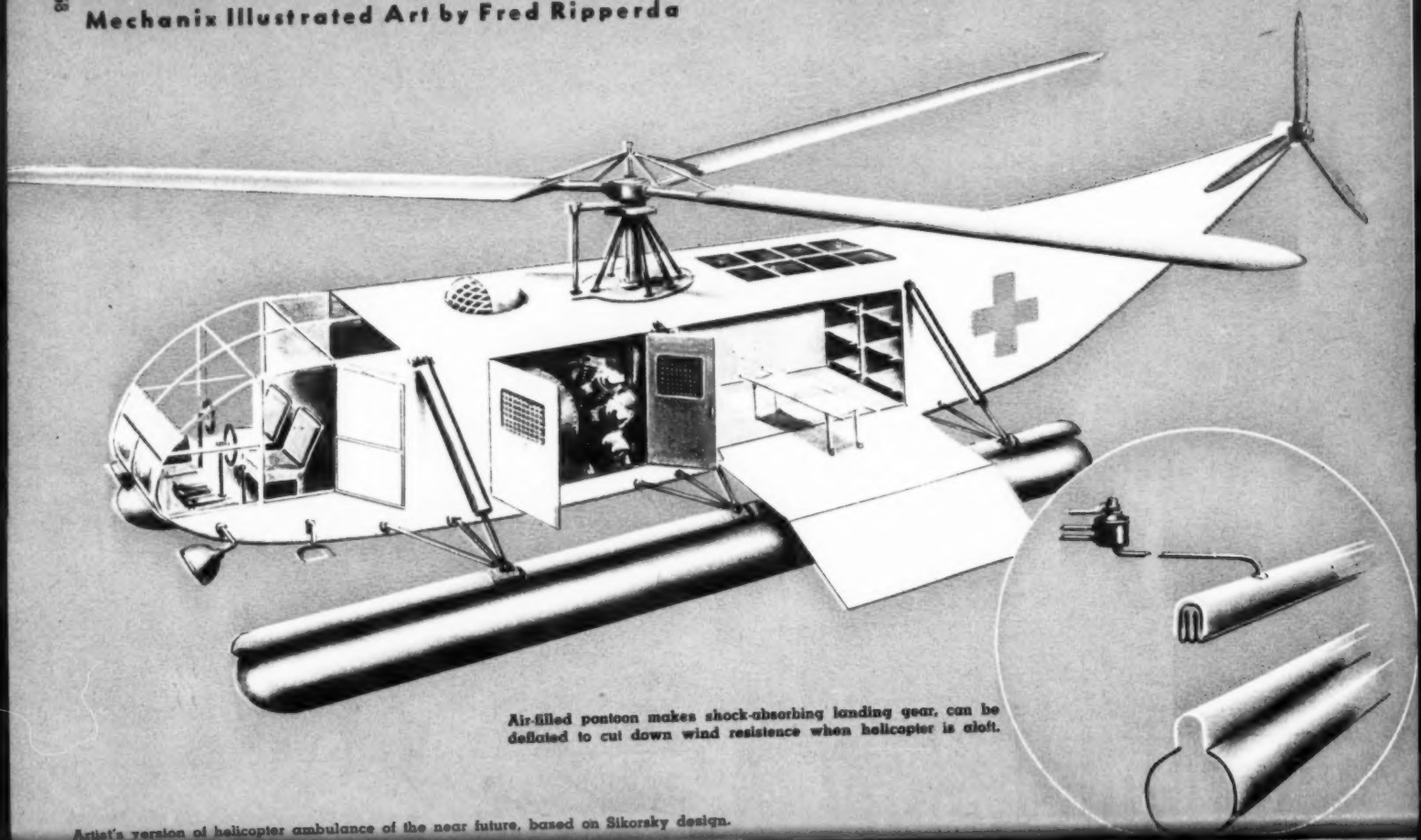
We decided on a real combat problem. As General Bruce explained, that would not be just a demonstration, but actual training for the men. I had then to acquire some idea of Tank Destroyer tactics—something new in modern warfare. Accordingly I watched training and maneuvers all the next day, Wednesday, and most of Thursday, and talked with men and officers for color and realistic army phraseology.

The General himself helped select the actual terrain for the broadcast—a sloping hillside on the edge of the artillery range. Orders were issued to units going out for night maneuvers in the hills to refrain from firing in our direction (they use live ammunition) and we in turn could fire only in certain directions to avoid hitting them.

About 1 o'clock Thursday a telephone company crew strung a line from an ordinary pole to the ground, and our engineer plugged it into his portable control board. At two-thirty the cast assembled for rehearsal: a platoon of medium tanks with security and maintenance jeeps, all radio-equipped; a squad of Tank Hunters, on foot; and a platoon of Tank Destroyers—fast armored half-tracks mounting 75's. Besides, we had another twenty men or so to handle small-arms fire, land mines and grenades for battle effects. Then we selected the points of operation and had a couple of run-throughs. Microphones to pick up dialogue, vehicles in motion artillery and small-arms fire were located at various points after considerable experimentation. This took nearly three hours. The length of our action on the air was to be exactly seven minutes—and no more. Substituting a sandwich and fruit for dinner, I wrote [*Continued on page* 146]

This Paramarine is telling a nationwide audience how it feels to complete his first jump.

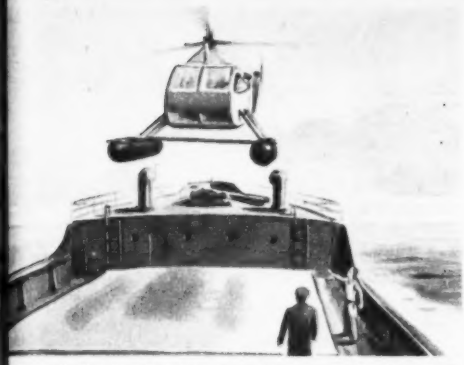
Mechanix Illustrated Art by Fred Ripperda



Air-filled pontoon makes shock-absorbing landing gear, can be deflated to cut down wind resistence when helicopter is aloft.

Artist's version of helicopter ambulance of the near future, based on Sikorsky design.

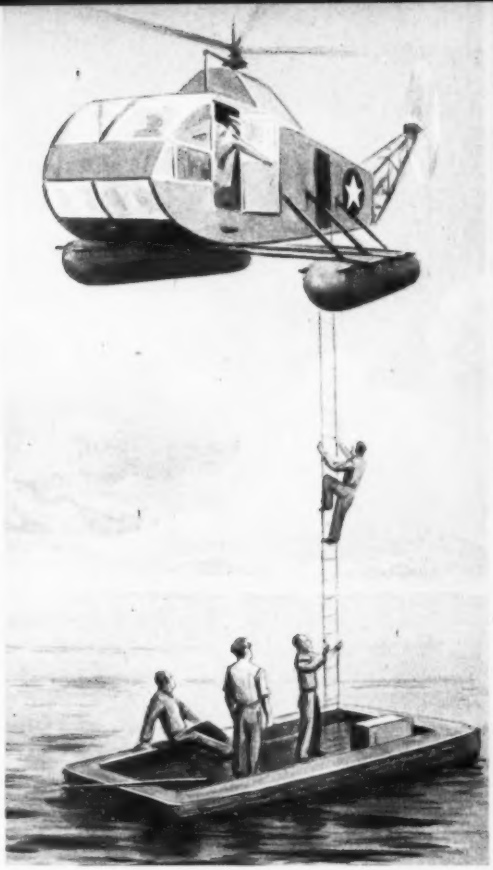
Artist's version of helicopter ambulance of the near future, based on Sikorsky design.



The deck of a freighter provides ample landing and takeoff area to accommodate a sub-spotting helicopter.

POSSIBLE HELICOPTER WAR USES

WHILE many uses to which the armed forces will put the Sikorsky helicopter are subject to censorship, those illustrated on this page are ideas which have been put forward in public. The Navy has announced that helicopters are being flown from decks of ordinary merchant ships to patrol a 600 mile gap in mid-Atlantic which regular planes cannot efficiently cover. England and Canada are also using helicopters.



Even in rough water, helicopters can effect rescues at sea, saving raft occupants without landing.

Flying at speed of sub, a helicopter can depthbomb with deadly accuracy, hover to make sure of kill.

For wartime communications, helicopters can lay telephone wires across impassable swamps, snow.

MEDICINE'S MAGIC WAND

Berman Locator, above, quickly spots metal in body when probe passes near it. Dial on case (background) tells story.

by Bill Reiche

EARLY on the morning of December 7, 1941, a group of medical men were assembled in an auditorium in Hawaii to hear a lecture. The speaker was Dr. John J. Moorhead, professor of surgery at the New York Post-Graduate Medical School and Hospital, medical director of the New York City Board of Transportation, lieutenant-colonel in the U. S. Army Medical Corps Reserve. His subject was the Berman Foreign Body Locator, a new medical weapon capable of locating precisely and instantly any piece of metal, however small, in a human body. He had with him the only instrument of the kind in the world.

Dr. Moorhead never finished that lecture, but before the day was over every doctor in Hawaii was thoroughly convinced of the Berman Locator's value. For on that day, almost as soon as the Jap bombs began to fall, the instrument was put to immediate and urgent use. And it performed miracles. With its help more than 960 operations were performed at Pearl Harbor. In more than one case, extractions of bullets and bits of shrapnel were made which would not have been possible without it.

Since passing that stiff and desperate test the Locator has gone into large-scale production. Though there are still not enough of them, Locators have helped the medical men of our armed services on every front all over the world. Before the war is over, many an American fighting man will owe his life, or the use of his limbs, to the surgical miracle which resulted from the inspiration of a brilliant doctor and the technical skill of a subway engineer.

For the Locator performs for a surgeon a unique and vitally important service. A slug of metal in a man's body may be located by taking two or three X-ray pictures from different angles and correlating them. But in transporting the patient from X-ray room to operating table the object may move. Even under the best conditions, its location can be determined by X-ray only approximately, and much depends upon the surgeon's own

interpretation of the photographic plates. The same uncertainty attends the use of the fluoroscope. This uncertainty, and the surgeon's inability to check the position of his quarry while the operation is in progress, often lead to his making an unnecessarily large incision, with attendant damaging of tissue, and possibly the most serious consequences.

That is where the Berman Locator comes in. Its sensitive radionic probes locate any hidden metal not only accurately, within a small fraction of an inch, but conveniently and instantly, so that the surgeon may check his work every step of the way.

Its story began about four years ago. As director of New York's transit system, Dr. Moorhead was acutely aware of the perils and problems of industrial accidents, and had long seen the need for an infallible finder that could accompany the knife into the body.

He discussed the matter with Samuel Berman, one of the system's research engineers. Delicate surgical "divining rods" were not exactly down Berman's technical alley—he had spent most of his life making subways run more safely, more economically and more comfortably—but the scholarly, Russian-born craftsman began wrestling with the assignment in his own time.

For two years Mr. Berman sweated over his unusual task. Temporary success would yield to failure—a promising tack would bring him to a scientific blank wall in an electrical blind alley. Finally he hit upon the right type of probe to survey the affected area of the wounded patient; he perfected the sensitive inductance coil which would give the alarm when it detected a near-by fragment of metal, and he brought to perfection the super-intricate wiring system which faithfully transmits the alarm to the meter on the panel of the Locator. The first model was finished in June, 1941. It was in the course of a demonstration tour with this model, the only one in existence, that Dr. Moorhead was at Pearl Harbor on that fateful day.

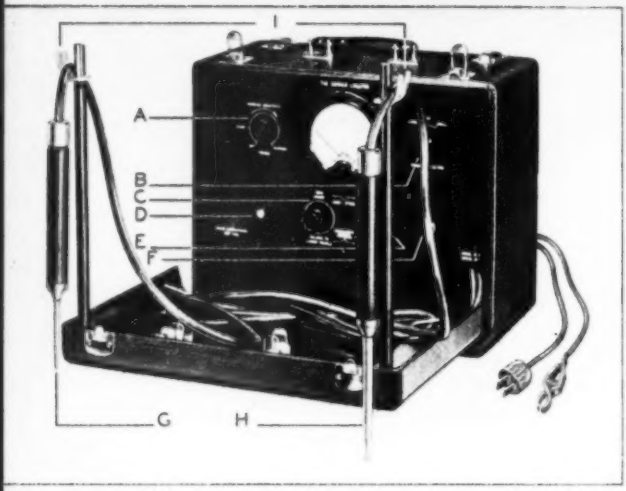
Specific details of the Locator's construction and operation, of course, are classed as restricted information now. But a clear general picture of how it works has been released.

It has two probes, one about the size of a fountain pen, for external investigation, and a smaller probe for use within the wound or incision. Both are connected by rubber cables to the Locator itself, which is about the size of a portable radio, and weighs 20 pounds. In the end of each probe is an inductance coil which is part of a delicately balanced electrical circuit. When any magnetic metal enters the field of sensitivity, the circuit becomes unbalanced and the degree of unbalance, or proximity of the foreign body, is accurately reflected in the meter reading. The sensitivity of the meter can be varied so that the maximum reading does not exceed the meter's ability to indicate it. The Locator can be operated on 110 volt alternating current or on an automobile storage battery with a 100 watt converter. This greatly increases its usefulness in combat areas.

To determine its depth from the skin surface it is necessary that the dimensions and composition of the foreign body to be removed, be known. These characteristics can be ascertained by X-ray. The larger finder is then passed over the surface of the skin until the maximum meter reading is obtained. The

Samuel Berman, with early version of metal detector.

Dr. John J. Moorhead. He was explaining it at Pearl Harbor—



Berman Locator unit and parts. (A) Power and sensitivity control. (B) Probe Selector switch, turns probes on and off. (C) and (E) Tuning knobs, obtain maximum sensitivity. (D) Protective fuse. (F) Pilot light. (G) Small probe for use inside incision after surface detection by large probe (H). (I) Supports to suspend probes when not in use. Light socket plug and ground shown behind case.

reading is noted and the skin is marked. An object similar to the foreign body is held at varying distances from the probe until an identical reading is obtained. Since air and body tissues have the same magnetic permeability the surgeon can tell just how far beneath the skin his quarry will be found and he can make his incision, confident that he's on the right track. The smaller probe is used within the incision in exactly the same manner, enabling the operating doctor to keep a continuous check on the distance and the direction in which the particle sought lies from his knife.

It goes without saying that all extraneous metal is removed from the probe's field of sensitivity. The patient is raised at least ten inches from the metal operating table, plastic retractors are used instead of metal ones, and vessels are tied off and clamps removed.

Pearl Harbor was by no means the first test this life-and-limb-saving device had undergone. Its first use was on a New York City policeman who had been struck by fragments of a bomb found at the New York World's Fair in July, 1939. More than two years after the tragedy, in November, 1941, the officer was still suffering severe pains in his ankle. Dr. Moorhead, at the Reconstruction Hospital Unit of the Post-Graduate Hospital, without supplementary aid of X-rays or any other technique, removed several bomb fragments. Later he used the Locator to find and remove a bomb splinter from the Achilles tendon of another victim of the same crime.

In an Eastern hospital last year a middle-aged man was to be operated on for open reduction of a fracture with the use of spinal anesthesia. When the anesthetic solution failed to flow it was discovered that two inches of the needle had broken off and remained in the patient's critical spinal area. Using both the external and internal finders, the shaft of steel was located and removed.

Reported the opening surgeon to Mr. Berman:

"This whole procedure took fifteen minutes, including local novocain infiltration. Had I attempted this operation without the radio-Locator I am certain that there would have been a great deal more tissue damaged and perhaps failure in removal of the needle." The dangerous, twin-pointed needle was found, incidentally, at a spot which didn't coincide with the wound made by its entrance.

Ten minutes was all that was required for a surgeon using the Locator in a Manhattan hospital to remove two bits of a needle from the thumb of a sewing machine operator. One was no larger than the point of a pin, and the doctor who removed it stated that: "It undoubtedly could not have been found by any other method."

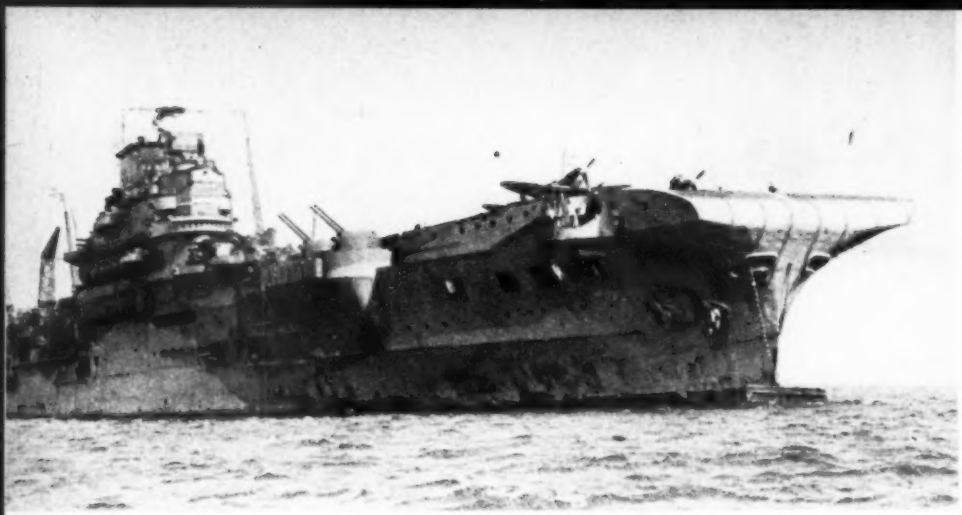
Such a device as the Berman Locator could have saved thousands of lives, including many of famous men, had it been perfected a hundred years ago. A notable instance was that of President James A. Garfield, who died 62 years ago with an assassin's slug in his abdomen while a covey of doctors, an anatomist and Alexander Graham Bell took turns in attempting to ascertain the slug's exact location. The doctors, headed by Garfield's longtime friend, Dr. D. W. Bliss, could arrive at no decision in this grimly fatal guessing game; Bell came to a general conclusion but was not sufficiently convincing to move the doctors to operate; the anatomist, Faneuil Dunkin Weisse, made the most accurate estimate by [*Continued on page* 150]

SCIENCE IN PICTURES

SUB SINKER

THIS is the U. S. Coast Guard's new Grumman J4F Widgeon amphibian, expected to come into wide use for offshore anti-submarine patrol. Powered by two 200-h.p. Ranger motors, the Widgeon carries a pilot, co-pilot, radio operator and mechanic, is fast, maneuverable and well armed. The Widgeon's principal weapons against U-boats are powerful depth charges, some of which are shown at *right* being fitted into the patrol plane's racks. Depth charges can be dropped from low altitudes, accurately aimed.

August, 1943

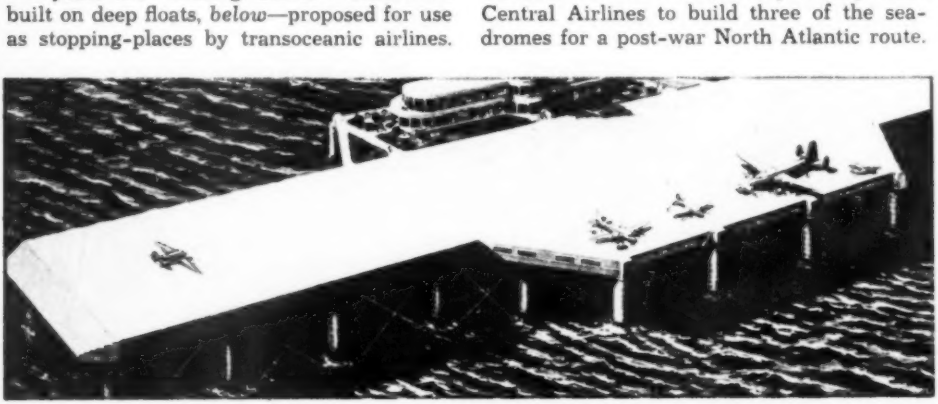


Flat-Top Flagship

PICTURED *above* is the most up-to-date of Great Britain's aircraft carriers, H. M. S. Indomitable. One of four new ships of the 28,000-ton Illustrious class, the Indomitable has seen plenty of action since her launching last year—most of it in the Indian Ocean, where she shot down 57 out of 100 Jap planes attempting to attack Ceylon. At *right*, Indomitable's flight deck. Note arresting gear.

Floating Phoenix

BACK in the news again after nearly 15 years are "floating islands"—seadromes built on deep floats, *below*—proposed for use as stopping-places by transoceanic airlines. The occasion this time is the application to the Civil Aeronautics Board by Pennsylvania Central Airlines to build three of the seadromes for a post-war North Atlantic route.



Aiming At Adolf

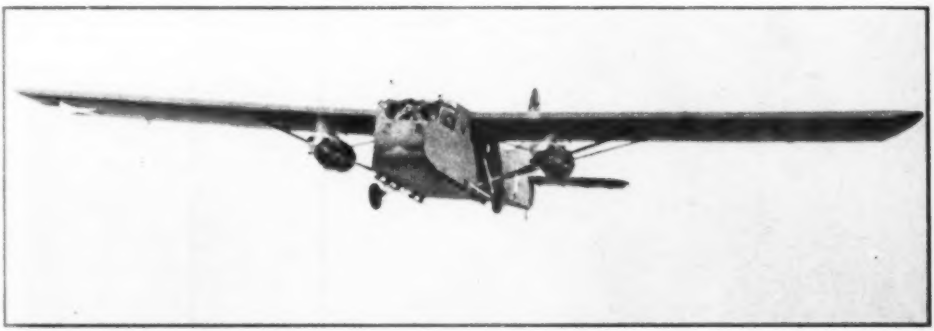
FOR the special job of landing troops on hostile shores, well known as the most difficult of all military operations, the U. S. Navy now has a new tool—invasion barges like the one pictured at *right*. Part of the Navy's Amphibious Force, these craft are manned by Navy and Coast Guard men; small, low in the water and fast they would, with skillful handling, be difficult targets for enemy gunners, even without their deceptive camouflage. Note unusual armor protection.

It Wasn't Fast Enough

THE eight-wheeled German armored car at *left* saw action in Tunisia, but not the kind of action its designers and builders intended for it: it was captured, in the general collapse of the highly touted Afrika Korps, by New Zealand troops. Note its flat armor surfaces, largely eliminated from newer U. S. combat vehicles because of their vulnerability to shellfire.

Army Freight Glides Under Power

PICTURED *below* is the U. S. Army's new aerial cargo carrier—a glider which, once boosted into the air by a fast tow, can be maneuvered like a regular plane by the power of its two small air-cooled motors. Power gliders like this combine with their inexpensive construction a flexibility of operation extremely valuable near combat areas.



Fire's A Fizzle

THE Air Force has just released details of a new fire-fighting marvel used at airfields. Vast volumes of carbon dioxide gas issue from the nozzle shown above and smother the fiercest flame within three minutes. The fizzle-gas fire fighter has sharply cut down fatal accidents in crash landings.

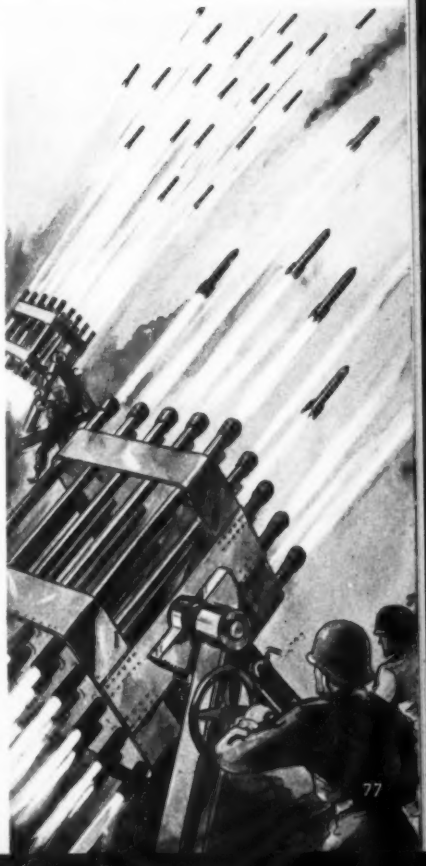
Water, Water, Everywhere!

THE Ancient Mariner, afloat on the sea, bewailed the fact that there was "water, water, everywhere—nor any drop to drink." Shipwrecked modern mariners have been killed by drinking sea water. A new device, *above*, distills sea water into fresh water and is now being installed in all lifeboats.

And Food!

WITH water provided for torpedoing victims by the still shown *above*, the Navy has also made provision for shipwrecked sailors to obtain food. Sailors will now be equipped with the elaborate fishing tackle outfit shown at *left*. Set contains various types of fishing line, a small harpoon, knife and buoyant whetstone, canvas gloves and a number of fish lures and baits, all neatly pocketed in an apron which is lightweight, and leaves arms free.

ROCKETS GO TO WAR



RECENTLY received in this country from Russia, the two photographs *above* show the Red Army's use of one of the new weapons of this war—rocket guns. Apparently more powerful than either the American Bazooka or the German rocket guns pictured in last month's MI, these Russian weapons are also distinctive in being mobile, like the truck-mounted one shown in the smaller photo. Last year MECHANIX ILLUSTRATED commissioned Willy Ley, well-known rocket expert, to predict how rockets might be used in war; a drawing made to his specifications appeared in the November MI. Note the similarity between Mr. Ley's design, reproduced at *right*, and the actual Russian rocket batteries.

Magnetic Sound

ON DISPLAY recently in Chicago was the device shown *above* for recording sound on wire. The recorder transmutes sound waves into varying intensities of magnetism on slowly moving, spool-wound wire. Played back on another machine, the wire reproduces the original sound.

Hypodermic For Rivets

PICTURED *above* is Anatole Andrews, of North American Aviation, with the rivet gun he recently invented to speed plane production. Built of miscellaneous old parts, the injector not only fits small rivets quickly into their places, but lightly waxes the holes so that the rivets stay put.

Industrial Airpower

IN THE Draw Bench department at Consolidated Vultee Aircraft's plant at Fort Worth pneumatically powered blocks operating at a touch are used to bend strips of steel or other metal to exact specifications. At *left*, one of these arms, with its end block, is shown in action under the hands of skilled workmen. Note brushing with lubricant of metal undergoing processing, to eliminate friction between it and the wiping block on pressure strokes, which will bend it to hairline accuracy.

But You Still Must Get Up

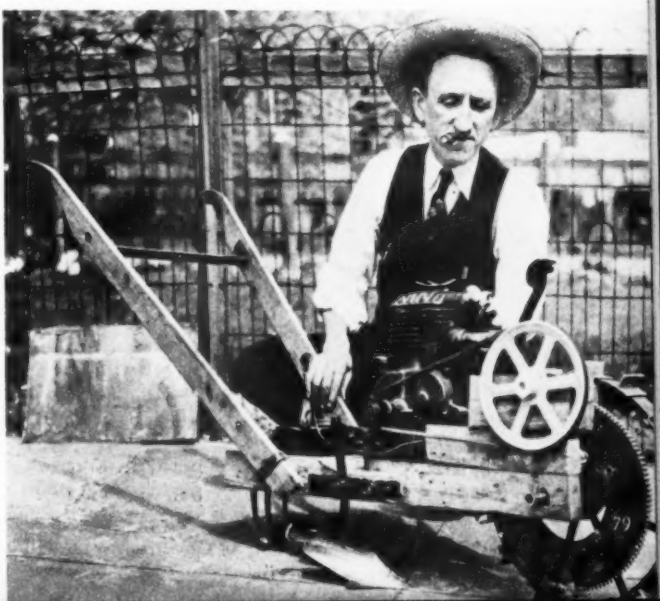
AN ALARM clock that does something useful, instead of just screaming, is the work of Albert A. Miller, of Madison, Wis. In the photo *above* Mr. Miller displays his wonder clock, which will not only wake you up, but will shut the windows, turn on the radio, and start your coffee (if you have any).

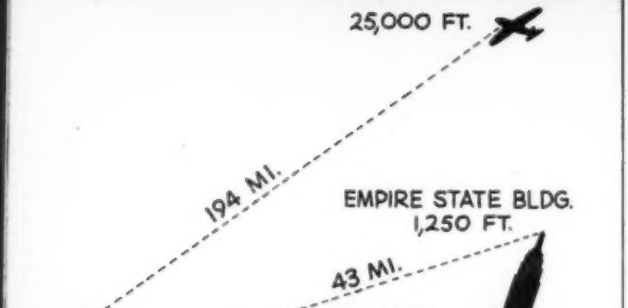
Gas For Fruit

COMING into wide use for preserving fruit is the sulphur dioxide treatment pictured *above*. Sulphur dioxide is dissolved in the proportion of one part to 50 of water, by weight. The solution has already been used for 250,000 barrels of fruit lend-leased abroad, at a cost of only 60 cents a barrel.

Backyard Power Plow

SORE-MUSCLED Victory gardeners who envy larger-scale farmers the conveniences of machinery should emulate Mr. Theodore Ort, of Detroit, who appears at *right* with his own miniature version of a tractor-drawn plow. Built out of various odds and ends, including an old wheelbarrow and some angle-irons, and powered by a one horsepower motor, it's just the thing for that backyard farm that looked so small last spring, and looks so big now. Note the "treads" on the wheel.



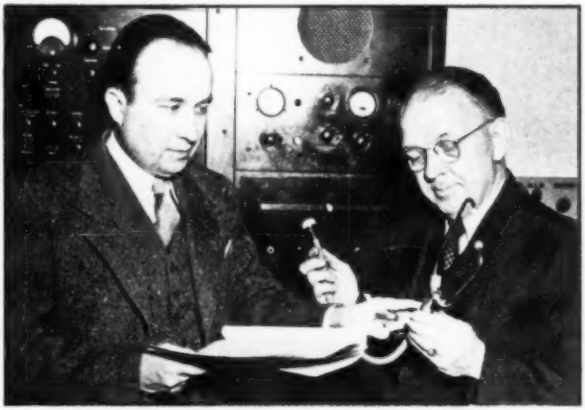


How Far Can You See?

PAN AMERICAN AIRWAYS recently developed what has been termed the "Vision Range" formula—for airline passengers who wonder how far they can see from various heights. Take the square of the distance in miles away from you, and multiply it by .67 to find how far the earth has "curved under" at that distance. Or take the square root of your altitude measured in feet, and multiply it by 1.225 miles to find your visual range. Thus, a person standing at sea level can see 2.9 miles; at 10,000 feet can see 122.5 miles.

Hears Body Noises

IF YOU have any peculiar noises in your body, this new acoustic stethoscope, *right*, developed by RCA Laboratories at Princeton, will make them audible. It picks up sounds in the human body that have never been heard before. Demonstrated by Dr. Harry F. Olsen and Technician H. D. Benson of RCA acoustics section, the instrument is as compact as the conventional stethoscope, but much more sensitive, may open new diagnostic frontiers.

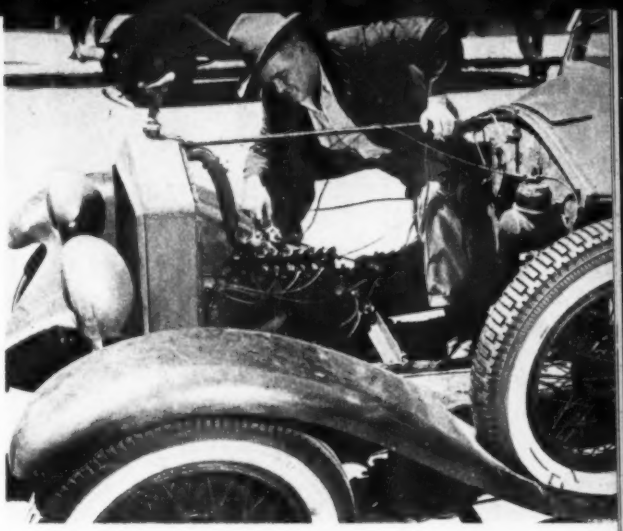


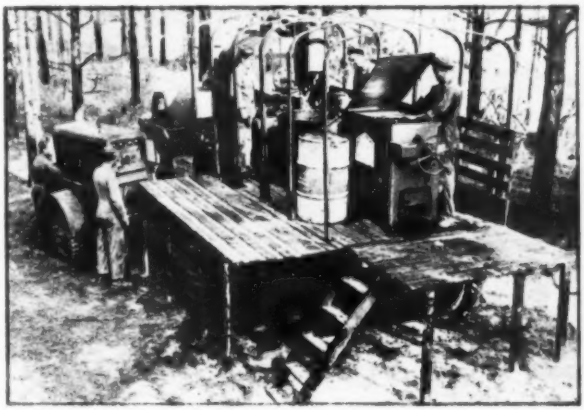
Jungle Hammock

HERE'S the latest thing in jungle sleeping equipment, now on display at the Army Quartermaster Branch Procurement Office in New York. It's a hammock with a waterproof canopy, insect netting, a canvas bottom with waterproof undershell, and slide-fasteners on the parts where weapons are kept. The camouflaged demonstrator shows how to man your tommy gun while relaxing in the hammock, suspended high enough to be out of reach of snakes.

Austin-Rolls-Royce

PAUL HUBBARD, World War veteran, bought a Rolls Royce once owned by showman George White, to use around New York. Then he ran into gas rationing trouble. The big, luxury-loving engine wanted too much fuel. Mr. Hubbard solved the problem by replacing the original motor with one from a tiny Austin, and now gets 25 miles to the gallon. It must keep Mr. Hubbard busy with the gear shift lever if he does much driving in hilly areas. But a Rolls-Royce is worth a little trouble.





New Oil From Old

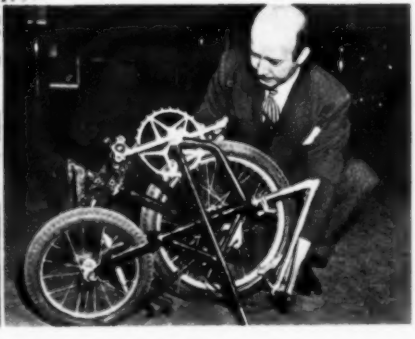
THIS mobile oil refinery does a job on approximately 200 gallons of oil per day. The oil that is fed into it is used crankcase oil, taken from more than 3,000 vehicles monthly. Army experts consider the oil refined by the apparatus to be as good as the original oil, or even superior. The process used is somewhat similar to the old process for refining motor oil from crude oil. The oil is purified in 100-gallon vats by fuller's earth.

12 Mile Per Egg

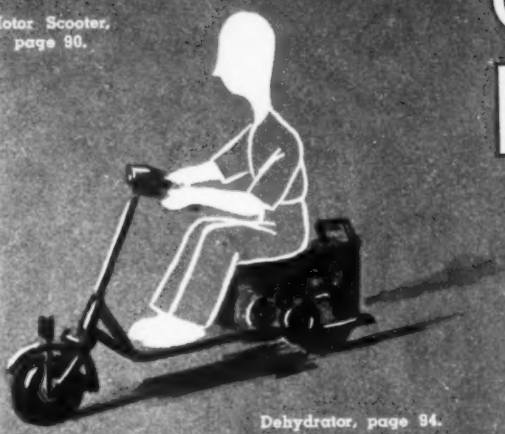
BRITISH aircraft designer Norman Sykes built this pedal car from scraps, to carry himself, his wife, and their two children. The youngsters take life relatively easy in back while Mr. and Mrs. Sykes provide the motive power by means of the pedals in the front. Handy for shopping, the compact little car makes about 12 miles an hour, and might be said to run on sandwiches. The cost was approximately $16, and took about three months to construct.

INVENTORS' SHOW

PICTURED on this page are new ideas that came to light during the recent Inventors' Exhibition and Hobby Show in New York. Shown at *left* is a collapsible bicycle designed for parachute troops, in use; *below*, inventor Jack Fried shows how the bicycle is folded up. The two bottom photos show the latest thing for wartime mothers —the baby pack, by means of which Junior can be taken along on shopping trips either papoose-fashion, *right*, or, *left*, on wheels.



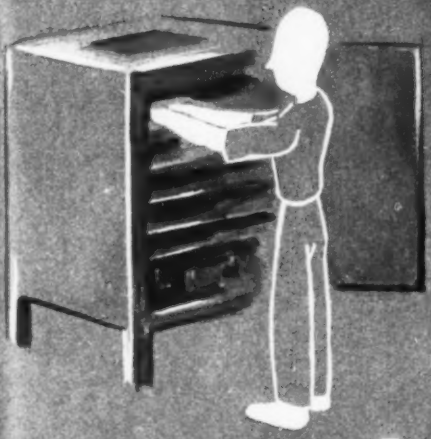
CRAFTS AND HOBBIES



Motor Scooter, page 90.

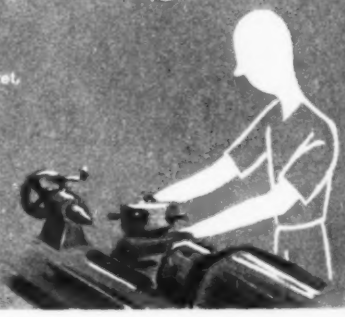
Maps of The Earth, page 100.

Dehydrator, page 94.



Tools for Boat Building, page 108.

Tool-Post Turret, page 116.



Kitchen Knife Rack, page 106.

PHOTOGRAPHY ● WOODWORKING
MAP STUDY ● MODELS ● RADIO
THE HOME WORKSHOP ● KINKS
IDEAS FOR SERVICE MEN

CROP BY VIGNETTING

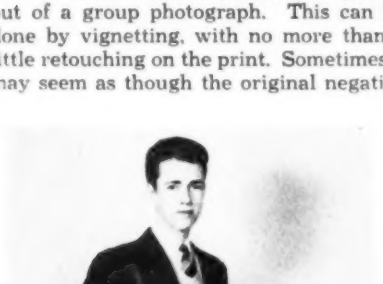
This simple technique removes unwanted detail.

by Charles Smith

WHEN you have a problem negative which you don't know exactly how to finish, the problem can often be solved by vignetting. The process gives the print a professional touch when done tastefully, and it also serves to eliminate many undesirable details that turn up so often on the negative.

Many things can be done with vignetted prints; wrinkled coat sleeves cropped out of portraits, large shoulders reduced or eliminated, or the entire composition changed.

It is often desirable to take one person out of a group photograph. This can be done by vignetting, with no more than a little retouching on the print. Sometimes it may seem as though the original negative



The family group portrait at the right is pleasing enough, but the young man prefers to have the particularly pleasant pose of himself by itself. The vignetted portrait, above, is the result. Photo at the top shows how this is done.

A vignetting tool may be made with a pair of scissors and a stiff piece of cardboard. Use center cut-out to change shape and size of vignetter's opening.

Print is finished with light application of powder to background area around head as above. Use cotton and blend background away from subject's head.

included the selected subject only. Very often snapshots can be vignetted into pleasing portraits and at little trouble and no extra expense.

Vignetting, like other photographic processes, is easy to do with a little practice and care; and needless to say, it takes no more time to make a good vignette than a bad one, once the technique is mastered.

Equipment is no problem at all. Any enlarger can be used without any expensive extras. Although a simple, adjustable vignetting tool can be purchased at little expense, this is not essential. A variety of efficient masks can be trimmed out of pieces of cardboard in a few minutes. Although the rapid adjustment feature of the factory-made vignetter may save time for the busy worker, it is sometimes necessary to cut out special shapes which that vignetter will not form.

As illustrated on this page, the masks are trimmed out of the cardboard with shears. A jagged edge is left on the inside to make the edges of the image blend properly without requiring that the mask be moved around very much during the exposure.

Several mask sizes should be cut, each

An artistic, hand-finished appearance can be given the vignetted print by nicking little saw-toothed gaps from powder background with strokes of art gum.

in the shape for which you would have most use. The most popular is the oval, egg shape, which is suitable for most head and shoulder portraits. It should be trimmed to point a little toward one side and this V peak turned

In this case a miniature was desired. The head was vignetted out of the negative with the aperture held close to the paper during the operation; this also eliminated the line in the background. The halo effect was achieved by rubbing in powder before the miniature was mounted.

in the direction of the shoulders in the negative. This makes the line of the vignette follow the lines of the body's pose. The egg-shaped mask can be inverted and twisted around to print seated poses of babies full figure as well as many other types of composition.

To eliminate the necessity of making too many masks, an oblong piece of cardboard can be cut out with one edge straight and the other curved. This board should be trimmed all around the outside with a jagged edge like the one illustrated. Then, when you want to change the shape of your stock vignettes slightly, this cardboard can be placed on the mask and held in the proper place by the fingers or paper clips while you make your exposure.

The actual work of making the exposure is very easy. The mask is held between the paper and lens—just a little closer to the paper. Experiment will show you the best distance for the effect you desire; too close to the lens will diffuse the lines too much and tend to lessen the exposure around the edges. This may cause trouble in head and shoulder portraits by unnaturally lightening the hair of a girl or killing the separation between the subject and a light background.

On the other hand, holding the vignetter too close to the paper will cause the outline to be too sharp and maybe show its jagged teeth; especially if it is not kept in slight motion during the exposure.

Always hold the vignetter in place when you make a test strip, because the vignetting affects the exposure slightly. It diminishes the total effective light on the paper, making it necessary to give a slightly longer exposure than would be required for a straight print of the same negative.

Finishing the vignetted print after printing is very important. If the background is pure white it looks too commercial and washed out to make a suitable portrait; and if partially-vignetted unrelated objects remain, they are often confusing enough to distract attention from the subject itself. The most popular and simplest method of finishing is done with powders applied by hand.

The powder can be prepared easily by rubbing regular pencil lead with sandpaper or shaving it off with a sharp blade. This powder may be used alone, or, if the surface of the paper is not exactly smooth, it may be mixed [*Continued on page* 136]

Negative Integrator

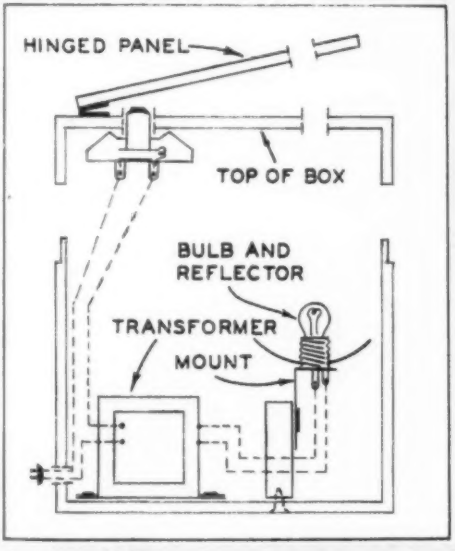
USING a photoelectric exposure meter, this excellent densitometer can be made with little trouble and expense. Because it uses such a small light source, heat is entirely negligible and there is no danger of warping negatives. In spite of the size of the bulb, the arrangement of the reflector makes it possible to take readings from areas ⅛" in diameter and even smaller if a meter having a "low-light" scale is used.

The materials needed are: a small wooden box, a battery or a 6-volt doorbell transformer for use with AC outlet, a pilot light mount of the screw-on type, a 6.2-volt flashlight bulb, a push-button switch and a reflector from an old flashlight.

First drill two ½" holes in lid of the box. Directly below one hole the pilot light mount is fastened on a small pillar screwed to the bottom of the box. Below the other hole is fastened the push-button switch. The transformer is screwed firmly to the bottom of the box and the primary leads are taken through the switch to the 115-volt supply. The secondary leads are soldered to the terminals of the bulb mount. Over the light hole on the lid of the box is glued a thin piece of cardboard having an 8" hole punched in the center. Lay a piece of tissue paper over this hole and focus the light from the bulb below by raising or lowering the reflector, held in place by friction tape wound around the bulb [*Continued on page* 136]

This device will check accurately negative contrast.

Drawing and photo show construction. Battery may be used instead of AC current and transformer.



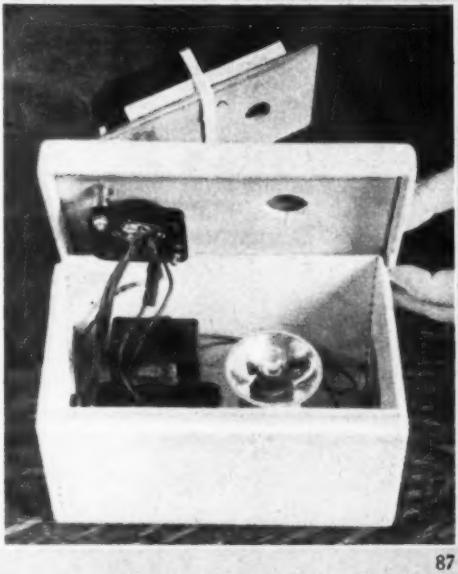
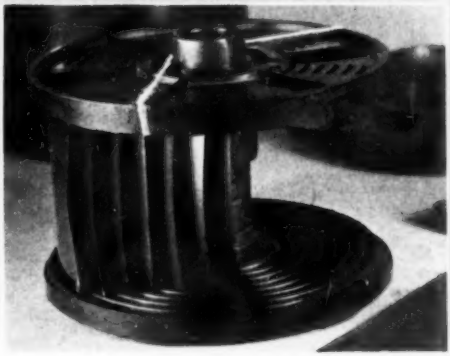
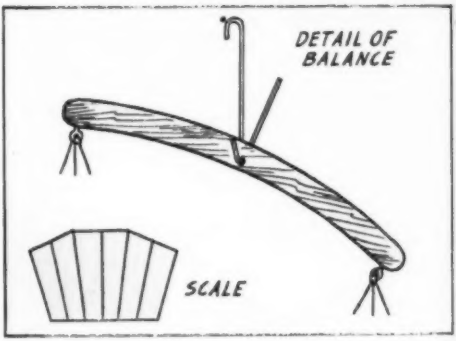


PHOTO KINKS

You can develop eight pieces of 6.5 x 9 cm. or smaller sheet and cut film in a 20 oz. film tank as follows: File two notches on each side of the top reel in a straight line in front of center hole. Load with seven pieces. Run cord or elastic around top and in cuts. Then slide in the eighth piece of film.—L. Maneval.



A wooden and a wire clothes hanger, the tops of two coffee cans, a piece of plywood, string and two screw eyes are the only materials necessary to build the darkroom balance shown above. Cut the wire hanger into two pieces, 8" and 16" long. Take out the hook of the wooden hanger and insert the 8" piece halfway in hole. Drill hole through center of wooden strip and insert the longer piece of bent wire.—R. Gross.



A film spool with a flat metal end will provide an extremely simple method of opening a new box of cut film if used in the manner illustrated in the photo below. Push edge of spool through sealing paper which holds box cover and push the spool forward.—J. Modroch.

Screw a strap to the wall of your storage closet as shown in the photo at the left and you will have a very convenient means of setting away your camera without dismounting it from the tripod. The strap will hold your camera upright and out of way.—J. Modroch.

PHOTO CONTEST

FIRST PRIZE ($10.00) "Bonnet Girl" by John Maker, Detroit, Michigan. Taken with Rolleiflex on Super XX film. **SECOND PRIZE** ($5.00) "Rhythm of the Islands" by Jack Bagnall, Huntington Park, Cal. Taken with a 4x5 Graflex on Triple-S Pan. **THIRD PRIZE** ($4.00) "Whatever Happened to Rommel" by Jack Garber, Brooklyn, New York. Taken with Rolleiflex on Agfa Supreme. **FOURTH PRIZE** ($3.00) "Lubrication Service" by Ed Arnold. Taken with Argoflex on Superpan Supreme.

2nd PRIZE ↓ **1st PRIZE** →

Submit prints for this month's contest unmounted—no larger than 8x10 inches. With each print list your camera, film, lens opening and shutter speed, illumination, and developer. Write your full **NAME** and **ADDRESS** on the back of each print, and wrap securely with cardboard or corrugated stiffeners. If you want unused prints returned, **YOU MUST ENCLOSE RETURN POSTAGE.** (Published Prints cannot be returned.) Address: Photography Editor, **MECHANIX ILLUSTRATED**, 1501 Broadway, New York, 18, N. Y.

GAS RATION SPECIAL

Go to market, beach or visit friends on one of these babies and forget your gas worries. You can cover 100 miles or better on one gallon of precious fuel.

by Howard G. McEntee

WITH gasoline and oil getting scarcer all the time, it behooves those of us who are able, to arrange our transportation in such a manner that a little of these commodities will go a long way. A small motor scooter is one of the most economical forms of powered transportation. Unfortunately the supply of these vehicles is limited, with new ones unobtainable, and used ones scarce and prohibitively priced. The answer seems to be "build your own."

The scooter to be described was evolved after the writer secured a second hand engine in fair shape. This was carefully reconditioned, and worn parts replaced, whereupon it was found to be very reliable in operation. This engine is a Lauson RSC, rated at 1.5 H.P., but any engine of from ¾ to 2 H.P. or so is satisfactory, as they are all of about the same size and general arrangement. The prospective builder will probably be unable to secure a new engine, but the second hand field is very large. An advertisement in the local newspaper will usually bring results.

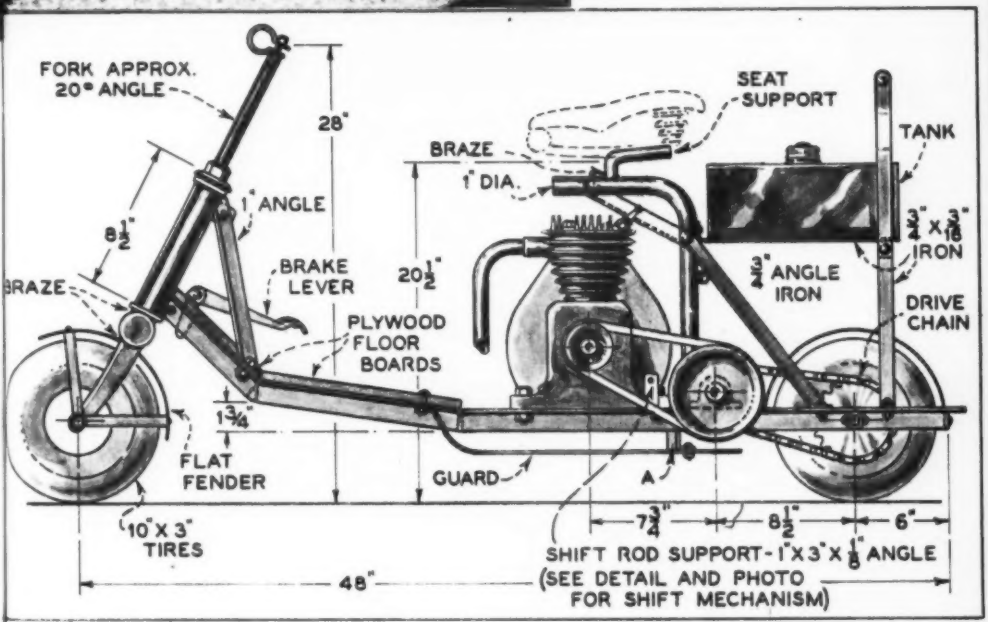
Only general dimensions will be given as a building guide, since the construction will

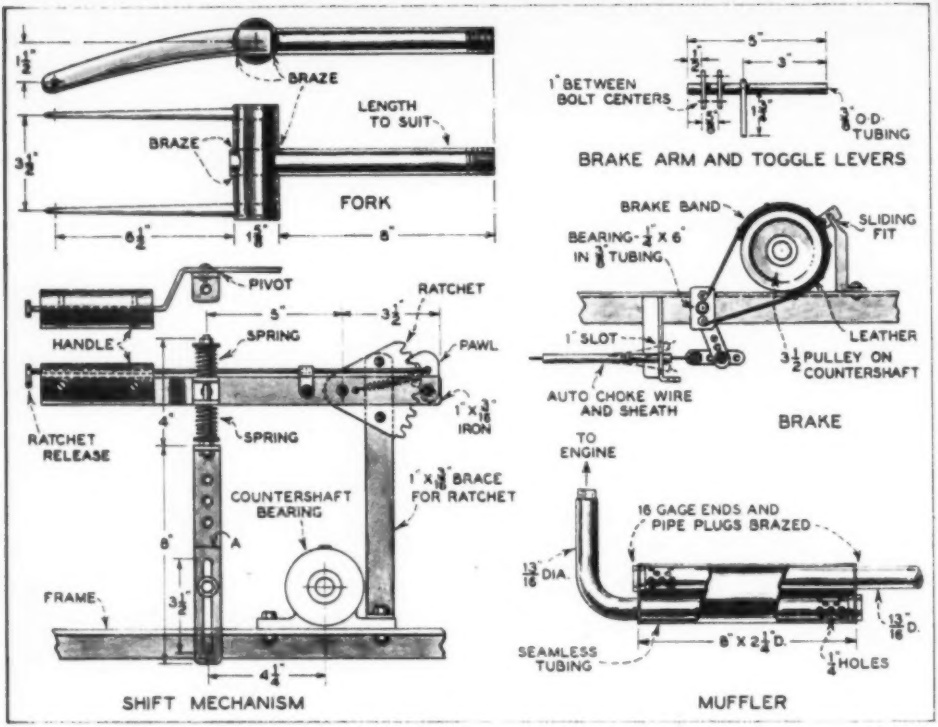
naturally be governed largely by what parts the builder can gather together, as was the case here.

Construction starts, of course, with the frame, which is made of $1\frac{1}{8}$"x$\frac{3}{16}$" soft angle iron. Old beds are a fine source of this material. First the side pieces are cut to length; then with a hacksaw, slots are cut at points A and B (see drawing) on the vertical side, up to but not through the horizontal side, or, in other words, to the apex of the angle.

The pieces may then be bent easily in a vise. After each side member is bent at the two points, and the three cross pieces are cut to size, together with the center motor support piece, they are about ready for welding. First, however, six slots should be cut, four for mounting the engine and two for the rear axle. Those for the engine must be positioned

Left: Completed scooter with lights, horn and rear vision mirror. Some states require twin headlights and tail light for these vehicles. Check with your Motor Vehicle Bureau. Below: Side view shows principal construction points. Motor is at right angles to chassis.





Parts details. Most materials can be obtained from junk. Frame is made from old bed rails.

according to the particular unit to be used, but should be measured so that the motor pulley comes at about the point shown. The welding can be handled by any well equipped auto repair shop.

After these initial welds are made, the side members must be cut once more at points C so that they may be bent inward at the front.

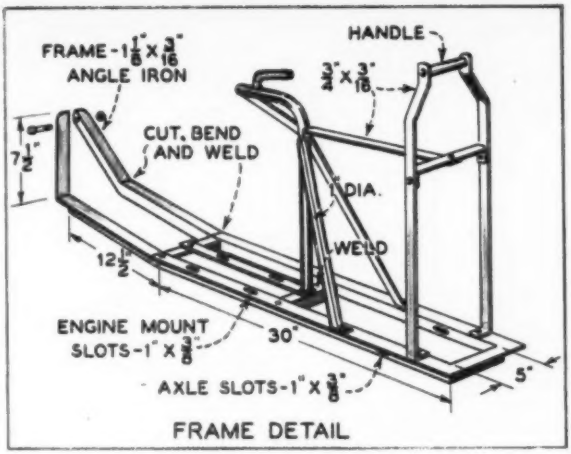
The bearing for the front wheel fork on this scooter is a cast iron piece about 7½" high and with a tubular stub at top and bottom. It was made for heavy commercial delivery bicycle use, but a bearing tube from an ordinary adult bike will do very well. This piece is held between the upward and inward bent front ends of the frame with a single bolt. The bracing pieces running from points C on the frame up to the top of the bearing tube are of 1"x1⅛" angle iron bolted at top and bottom and also welded at the latter point. The tube should slant to the rear at an angle of about 20 degrees.

At points A on the frame a $\frac{3}{16}$" bolt is run from side to side with a spacer of small diameter gas pipe between the side members.

The front fork will have to be built up as there is no bicycle part of the correct size. The lower ends, or prongs, of the fork are cut from an old bike frame and are brazed to a piece of 1⅝" diameter tubing which is 5" long. The prong pieces should be fitted through oblong holes cut in the lower side of the tubing and curved to butt snugly against the inside of the upper portion. The stem of the fork is also cut from a bicycle so as to make available the threaded upper end. This piece is brazed into the 1⅝" tubing which is first bored or filed out for a snug fit. The bearings and cones from a bicycle fork assembly, together with the nuts and washer that hold them in place, complete this part of the machine.

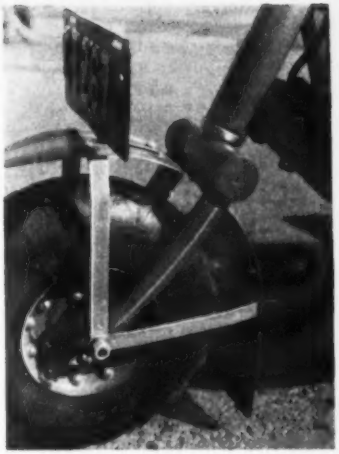
The neck is much longer than those used on bicycles and must be built up from one of the latter plus a piece of tubing that will fit inside the stem of the fork. The same tightening arrangement as used in standard bike practice is satisfactory. Bicycle handlebars and rubber grips are used.

The seat is mounted over the motor and is held on a cut-down bike seat post brazed to



FRAME DETAIL

Here is bare frame with seat support and engine mount shown. Cut slots for hold-down bolts to fit your particular motor.

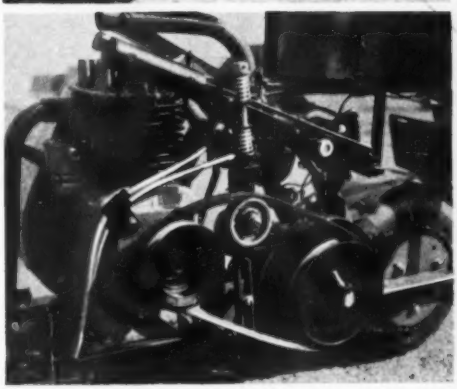


Closeup of sturdy front fork construction. Licenses are required by some states.

a curved piece of 1" diameter tubing. This tubing is braced by two pieces of $\frac{3}{4}$"x$\frac{1}{8}$" angle iron which run back to the main frame. The seat itself is of a large, well sprung type that makes for comfortable riding. All joints of the seat support are brazed and the whole tripod may be removed from the frame by taking out three bolts.

We come now to the power and drive mechanism, where lie most of the procurement and construction headaches. The wheels are heavy duty type with ball bearings, carrying husky 4 ply tires of 10x3 size. The rear tire *must* be of the so-called "lug base" style, meaning that the tire has moulded ridges running crosswise around the inner circumference, which fit into slots pressed in the steel wheels. These ridges or lugs prevent the tire from slipping around the wheel under power. Do not try to use a smooth-type tire as it is wasted time, a fact ascertained by sad experience. Either style of tire, however, may be used on the front wheel. These tires are usually of single tube construction with no inner tube.

Wheels for these small tires are usually made in three pieces, consisting of a hub carrying the ball bearings, and two pressed steel discs to fit in the tire, the three sections held together by [*Continued on page* 132]

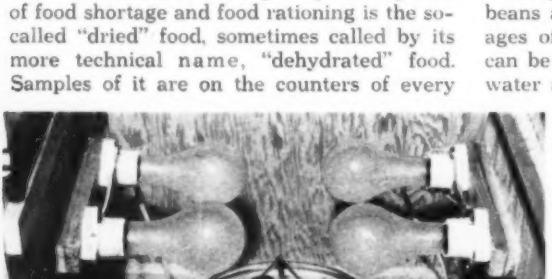


Above: Gas tank feeds motor by gravity. Dome-shaped gadget near wheel is generator. Right: Clutching arrangement is operated by idler pulley (center) which raises and lowers to engage or disengage driver pulleys. Wheel itself (with sprocket) is in turn driven by chain from sprocket on pulley shaft.

Now that your Victory garden has started to flourish and you're getting ready to bring in those juicy vegetables you have been talking about, why don't you dry up? We mean dry up the vegetables, of course. This dehydrator will dry them so you can keep them till winter.

FOOD DEHYDRATOR

ONE of the more popular types of foods on the market during the present period of food shortage and food rationing is the so-called "dried" food, sometimes called by its more technical name, "dehydrated" food. Samples of it are on the counters of every delicatessen and grocery store throughout the country. Milk powder, dehydrated prunes, beans and peas and even those small packages of mysterious, granulated chips which can be dumped into a quart or so of boiling water and will turn it into one of the most savory and healthful stews you have ever tasted, belong to this new trend in nutrition.



A "dried" food is exactly what its name implies—a food from which almost all the moisture has been extracted, one which has been thoroughly dried. What is the advantage of dehydration? It reduces the bulk of foods at least 10 times, and makes it possible to keep them for indefinite periods of time without deterioration. It is a much simpler process

Photo shows arrangement of 100-watt bulbs (connected in parallel) and horizontal fan.

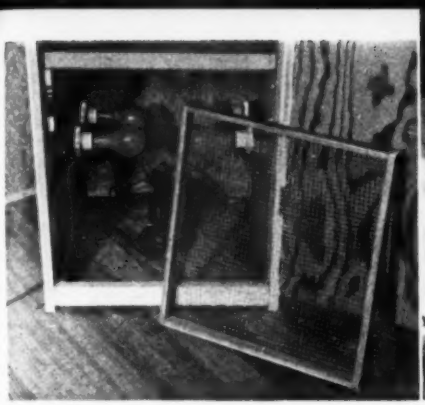


Photo above shows one of the five wire-mesh trays. Storage bags can be made of waxed paper with edges folded and stapled together as at upper right.

Semi-invisible hinge fits in door rabbet as above. Fan blows hot air from bulbs (below).

than canning, for it requires no laborious cooking and stirring, and waste is reduced to a minimum. To restore dehydrated foods to a freshness almost equal to new, it is only necessary to add them to boiling water so that they may regain the moisture they lost in the dehydrating process.

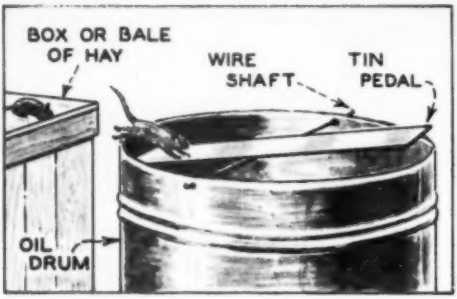
Here is a simple dehydrator you can put together in a few spare evenings.

Its initial cost is small, it's inexpensive to operate and it will go to work on your Victory garden vegetables such as string beans, carrots, spinach, etc., so they'll be where you can reach them when that "rainy day" comes along next winter.

It's made of soft pine and plywood. If the plywood is difficult to obtain, any of the composition wallboards on the market will make a satisfactory substitute. Make the framework of $\frac{3}{4}$"x$1\frac{3}{4}$" pine. The two sides are first: $36\frac{1}{2}$" high including $\frac{1}{2}$" for a foot on each of the vertical members. The side pieces connecting the members should be $14\frac{1}{2}$" long, making an overall depth for the dehydrator of 18". Nail a sheet of plywood 18"x$16\frac{1}{2}$" over the inside of the side frame, allowing a $\frac{3}{4}$" margin in front and back. When the sides have been constructed, connect them at top and bottom by $14\frac{1}{2}$" pieces of pine as shown in the photograph, making an overall width of 18". These pieces will set in the $\frac{3}{4}$" margin previously allowed when nailing the plywood to the sides.

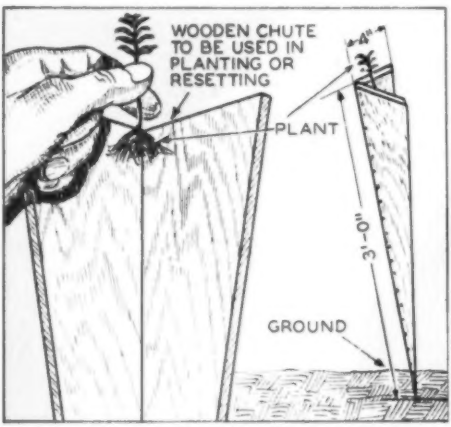
Cover the back with a sheet of plywood 36"x18", and the top with a sheet 18"x$18\frac{1}{4}$". The extra $\frac{1}{4}$" will cover the plywood back. Cut a 5"x5" hole in the top to allow for air passage. The bottom is left open. The door is made of 5-ply [*Continued on page* 140]

HINTS FOR THE VICTORY FARMER



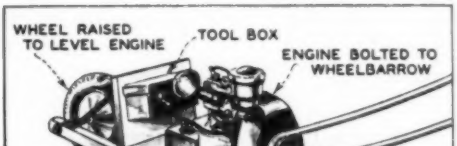
Automatic Rat Trap

A RAT TRAP which is automatic, gets results and will last indefinitely, can be made quickly and easily from old gasoline or oil drum. Cut the head from drum, punch two holes in rim and use heavy wire for a shaft. Make pedal of light tin, just big enough to clear sides of drum. Bring pedal to an exact balance on shaft so that it whirls at the slightest touch. For a scent, rub pedal and sides of drum with strong cheese. Fill drum half full of water and set near high box.



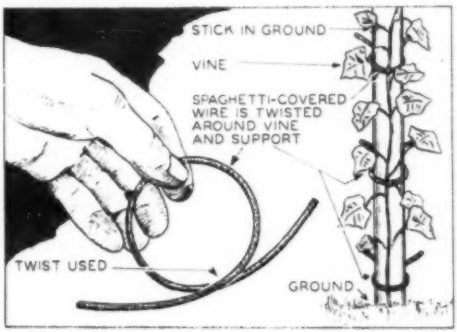
Wooden Planting Chute

DIGGING a small hole in the ground, setting in it a small plant and then tamping the earth around the roots sounds like an easy job, but after repeating a few thousand times, the ol' back begins to ache and the task takes on major proportions. The chute shown above is the remedy. To use: jab the point into the ground, rock back and forth to widen the hole, let the plant slide down the chute, pull out the chute and tamp dirt with foot.



Portable Gas Engine

THERE are many times on the farm or country estate when a bit of portable power is needed. The portable farm engine above will solve the problem very nicely. Take the sides from a flat-bottom wheelbarrow and bolt the engine to the base. Notice the elevator front leg and method of locking rear legs to the ground. Use long lag screws to hold legs to barn floor.

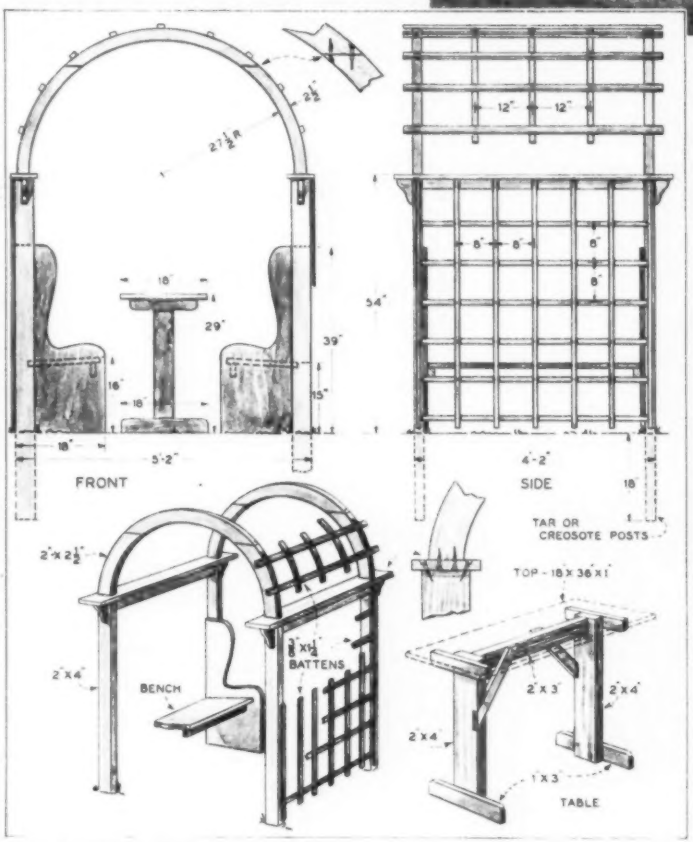


Ties For Garden Vines

SPAGHETTI-COVERED "push back" wire, used in radio work, is excellent for tying grapevine and creeping plants around the garden. Clip the wire into short lengths and tie the vine to the support with a single twist. When vines grow very rapidly, the wire is flexible enough to give and thus keep the vine from strangling.

Arbor of Non-Critical Material

A FEW hours of your leisure time will be sufficient for you to construct this attractive addition to your garden or lawn. Seats are fixed but the table is removable. Tar or creosote the ends of four 2x4's and set 18" in the ground, spaced as indicated. Nail on temporary battens and diagonal braces to hold them in place until the top is assembled and the structure otherwise completed. The two main arches are scroll-sawed from 2"x8" material and built up of three pieces each, lap-jointed and screwed as shown. Intermediate arches are battens secured to horizontal strips on the underside. Seats are secured to the corner posts, the battens serving as seat-backs. Note that the table is made narrow enough for easy access to the seats.



Short lengths and scraps of lumber are used to make this garden arbor.

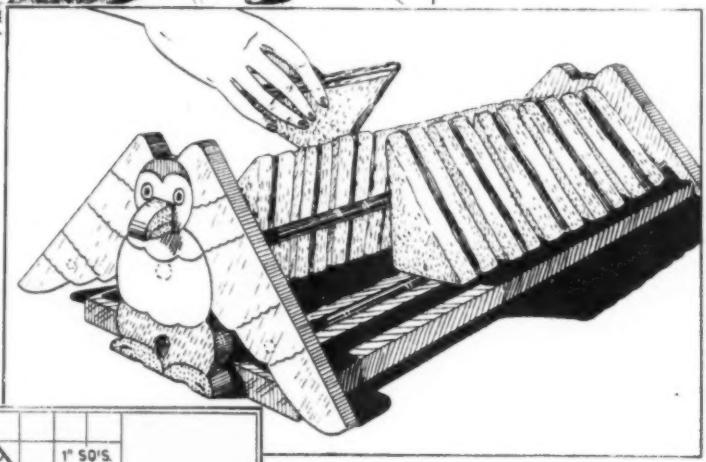
Follow the structural drawing at left. Paint white or leave in its natural color.

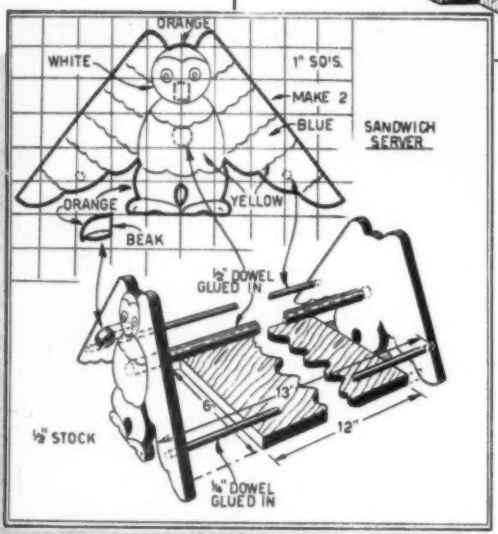
PICNIC

A sandwich server, a utensil holder and single serving trays.

by
R. L. Fairall

These three gadgets are easily made of scrap lumber and will help to lend atmosphere to outdoor picnics.

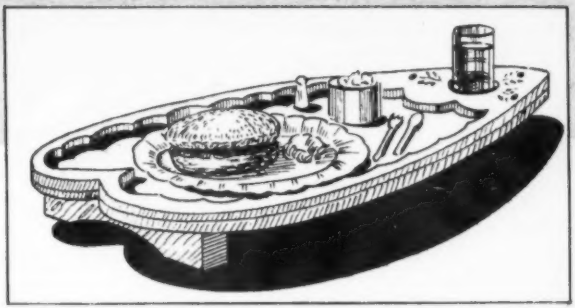


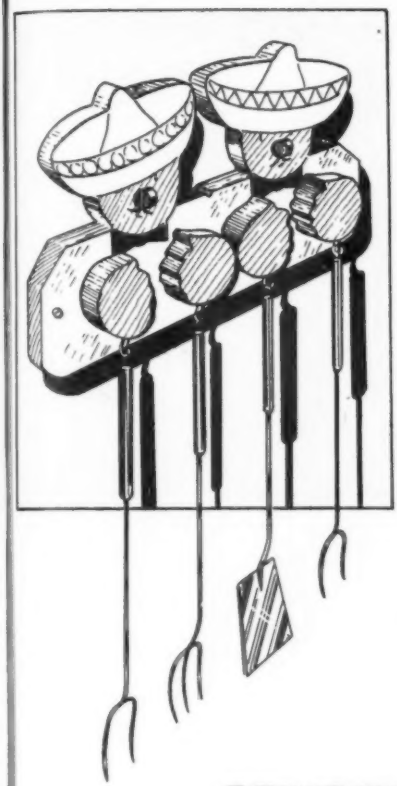


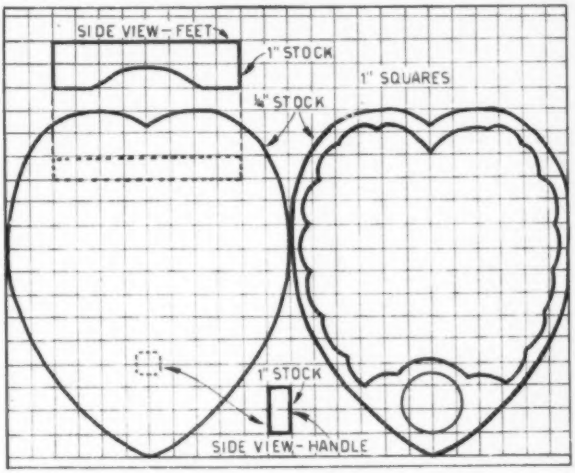
THE "Goony-bird" sandwich server is made of ½" surfaced stock. The two birds and a beak for each are jigsawed and the beaks are nailed and glued in place. The 6"x12" base then is cut and the birds nailed to each end. A ½" dowel and two ¼" dowels each 13" long are glued into the holes drilled for them in the bird sections as indicated by the dotted lines in the squared drawing. Finish the server in enamel. The wings should be painted blue with yellow scallops; the face white; the beak, legs, and top of head orange; the feet and body yellow.

The handy holder for barbecue utensils will hold forks, spatula and tongs. The main section and the noses for the figures are traced to ½" surfaced stock and

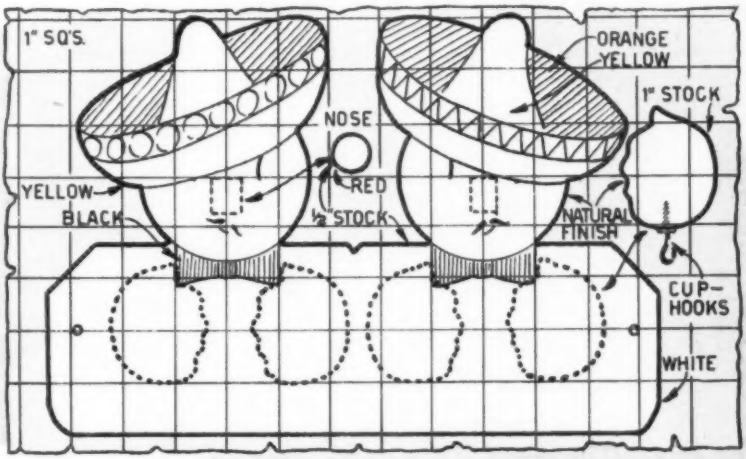
NOVELTIES







jigsawed; the four hands traced to 1" stock and also jigsawed. The two disks which are the noses of the figures are fastened to the faces by two nails driven through from the back. A cup hook is screwed into the under side of each hand [*Continued on page* 144]



THE SCHOOL SHOP

Conducted by Gilbert Paust

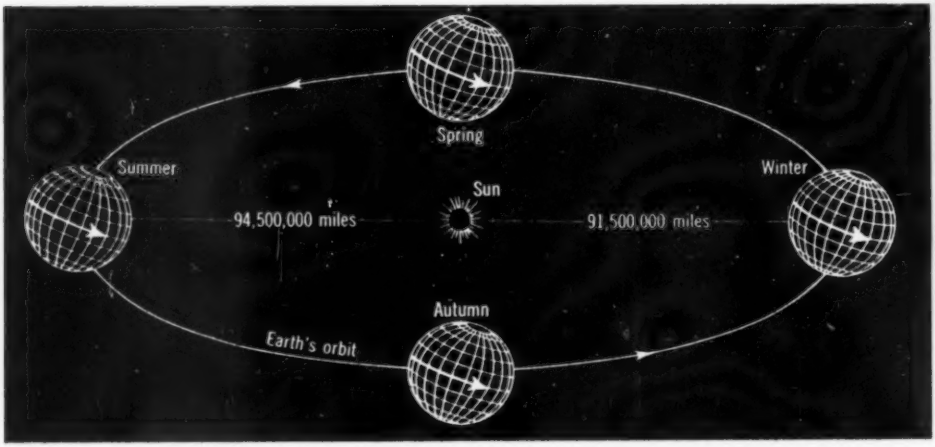
Ground Instructor and Lieutenant, Civil Air Patrol

Lesson 7—Maps of the Earth

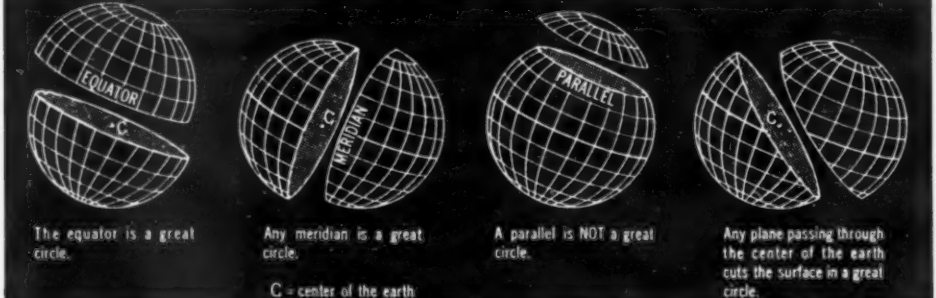
THIS is our first aviation lesson on Navigation and in it we're going to learn a few startling things about old Mother Earth—about her face in particular. Just now she's wearing a rather worried look because people aren't treating her as kindly as she deserves, but nevertheless her face hasn't changed very much through the centuries, and it presents to the modern pilot just about the same type of problem it presented to early navigators.

Navigation is the science of finding one's way from place to place on the earth's surface. *Air navigation*, or *avigation*, has to do with finding a course through the air above the earth. There are different methods of air navigation and we'll consider them all in due time, but for the present let's be content with a study of how we locate a place or *fix* on the earth, because we can't do any flying until we have solved this problem.

If Christopher Columbus were wrong and the earth were flat instead of round, navigation would be very simple indeed. All we would have to do would be to make a flat



Movement of the earth around the sun causes the different seasons. Rotation on its axis causes day and night. The drawing above shows these motions of the earth. The great circle is described below.


EQUATOR
C
The equator is a great circle.
C
MERIDIAN
Any meridian is a great circle.
PARALLEL
A parallel is NOT a great circle.
C
Any plane passing through the center of the earth cuts the surface in a great circle.
C = center of the earth

Diagrams Courtesy C.A.A.

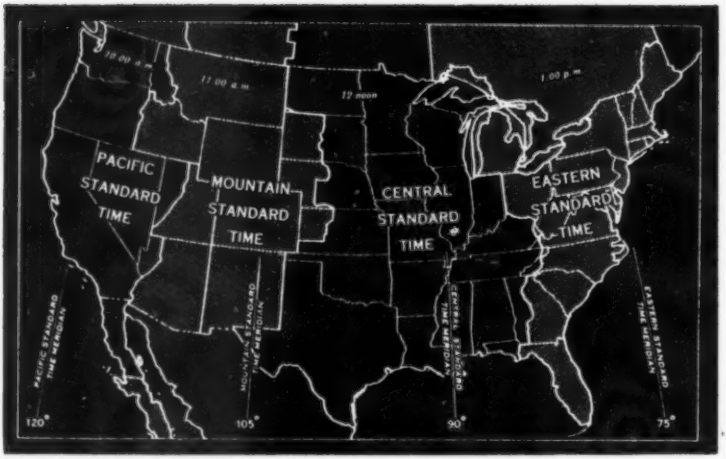
The problem of making an accurate, flat map of the round earth is not a simple one.

map of the flat earth, mark off our continents and cities, and select our courses just as we would choose our moves in a checker game. The earth is round, however—not exactly round but slightly flattened at the poles—and that complicates our map-making quite a bit. To make a flat map of a round earth is not a simple task.

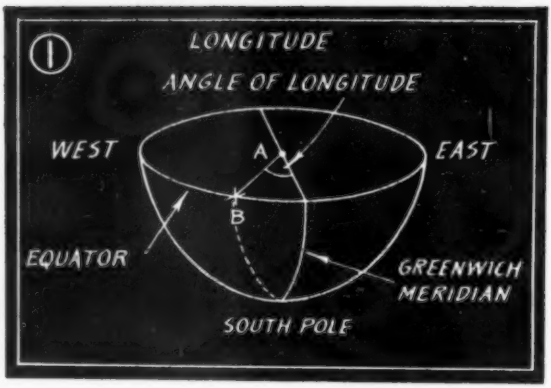
Let's take a brief look at the type of earth on which we live. It is a planet belonging to a solar system in which our sun is the center. It is approximately 92½ million miles from the sun and performs two important motions which we should consider. It rotates on its axis once every 24 hours, which motion causes day and night, and it also travels in an almost circular path around the sun once every 365¼ days, giving us the various seasons of the year. Every four years we add up the ¼-days and have a leap year of 366 days. Remember that the sun does not move; it is a fixed star. The sun does not rise in the morning and set at night; it is the rotation of the earth which causes this apparent motion of the sun.

All of us are familiar with the Equator. It is an imaginary circle drawn around the earth equidistant from the poles. Since there are 360° in every circle, there must be that number of degrees in our Equator, also. If the earth rotates on its axis at the rate of 360° (for one complete turn) every 24 hours (one day), by dividing 360 by 24 we get 15° PER HOUR which is the hourly rate of rotation of the earth. Our Equator can give us a little more information, too. Its length is approximately 24,870 miles. In its 360° are 60 x 360 minutes, for 60 min.=1° just as 1 hour of time contains 60 minutes. If we convert 24,870 miles to feet and divide by 60 x 360 to find the number of feet in 1 min., we get about 6080 feet which is taken as a standard for 1 *nautical mile*. Therefore 1 min. at the Equator

Photo by Herbert Gehr



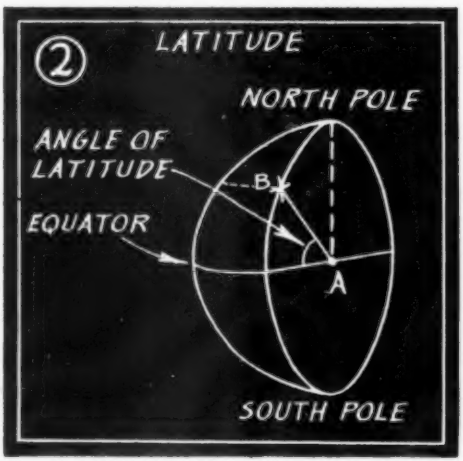
Four meridians divide the United States into four separate time zones or belts as in drawing at left.

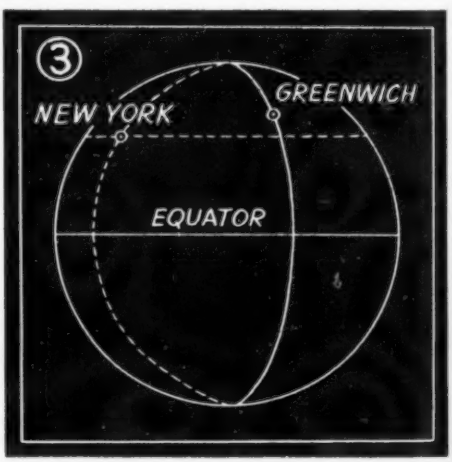


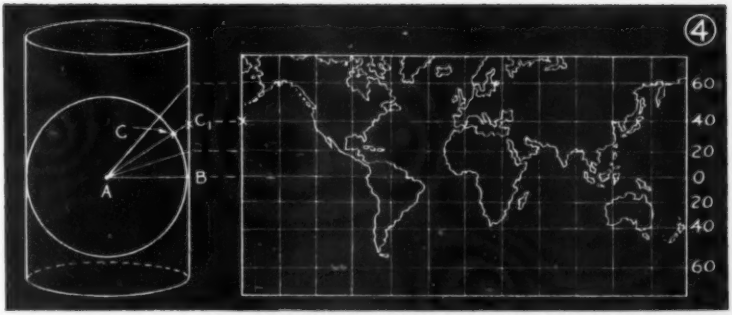
Latitude is the angular position of a point North or South of Equator. Longitude is its angular position East or West of Greenwich Meridian from 0° to 180°. Figs. 1, 2 and 3 explain.

equals 1 nautical mile, and 1° at the Equator equals 60 nautical miles. A *knot* is a unit of speed equal to 1 nautical mile per hour. It is *incorrect* to say that a ship travels at a speed of 25 knots per hour. Its speed would be 25 knots, meaning 25 nautical miles per hour. Remember these values. You'll need them for any advanced study you may take later.

Now let's see how we determine a *fix* on the earth. When you plan to meet a friend at the corner of X street and Y avenue in your own home town, you are establishing a fix. It is a point lying at the intersection of two lines. The same is done on the earth's surface. The avenue is a





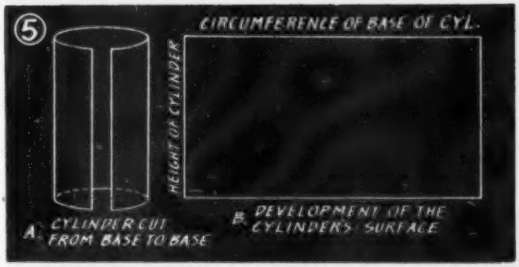


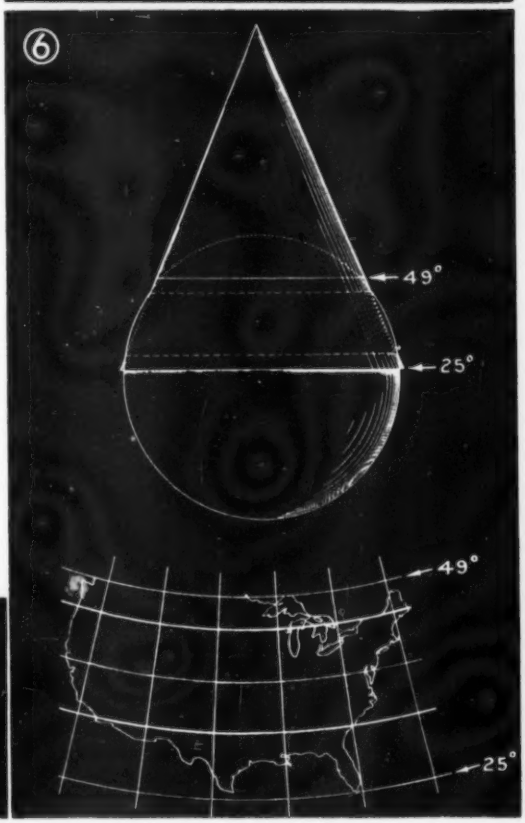
The Mercator chart is a cylindrical projection. Earth's surface is projected on sides of a cylinder as shown in drawings at right.

meridian of longitude, the street is a *parallel of latitude*. A *meridian* is an imaginary circle drawn around the earth through the poles cutting the earth in half. The *Prime Meridian* or *Greenwich Meridian* is one which passes through the small town of Greenwich, a suburb of London, England. *Longitude* is the angular position of a point East or West (from 0° to 180°) of the Greenwich Meridian. On page 102, Fig 1, if A is the center of the earth, the angle between the Greenwich Meridian and AB will be the longitude (West in this case) of any point on the meridian passing through B.

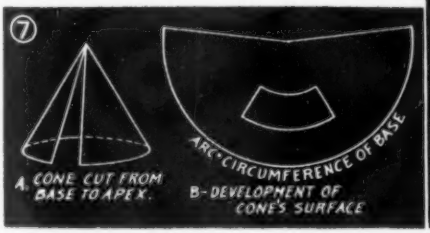
A *parallel* is an imaginary circle drawn around the earth parallel to the Equator. *Latitude* is the angular position of a point North or South (from 0° to 90°) of the Equator. In Fig. 2 the angle between the Equator and AB represents the latitude of every point on the parallel passing through B. In Fig. 3 New York lies approximately at the intersection of the 40th parallel North of the Equator and the 74th meridian West of Greenwich. Its position, therefore, is about 40° North Latitude and 74° West Longitude.

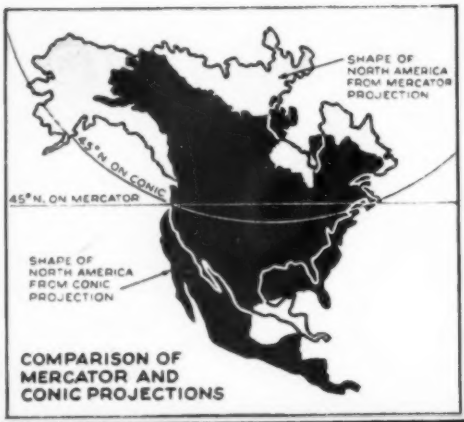
The United States is divided into four separate time belts which are

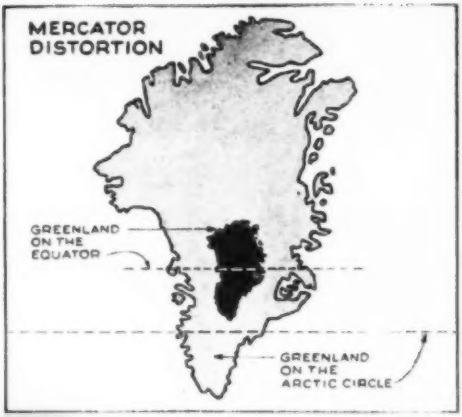

5
CIRCUMFERENCE OF BASE OF CYL.
HEIGHT OF CYLINDER
A. CYLINDER CUT FROM BASE TO BASE
B. DEVELOPMENT OF THE CYLINDER'S SURFACE

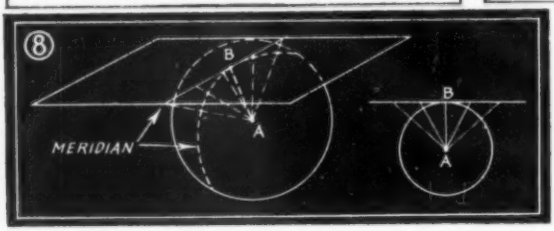


The Lambert map is a conic projection. The surface of the earth is projected on a cone.

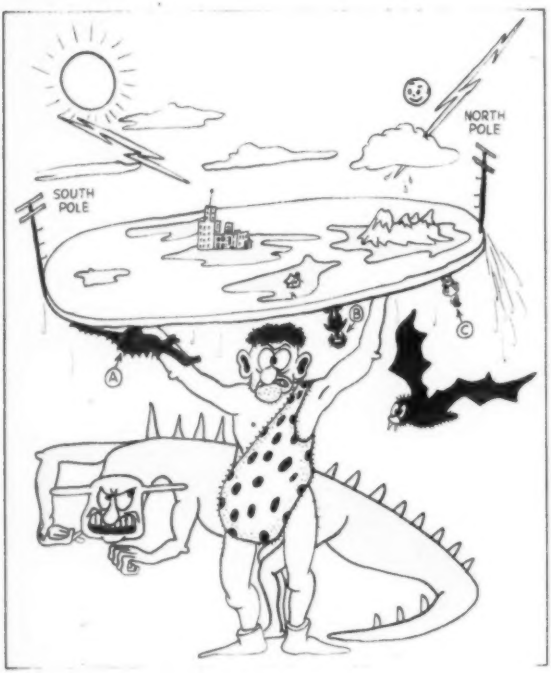



SHAPE OF NORTH AMERICA FROM MERCATOR PROJECTION
45°N. ON CONIC
45°N. ON MERCATOR
SHAPE OF NORTH AMERICA FROM CONIC PROJECTION
COMPARISON OF MERCATOR AND CONIC PROJECTIONS





Drawings at top show comparison of Mercator and Lambert projections. Gnomonic projection (on flat plane) is shown above.

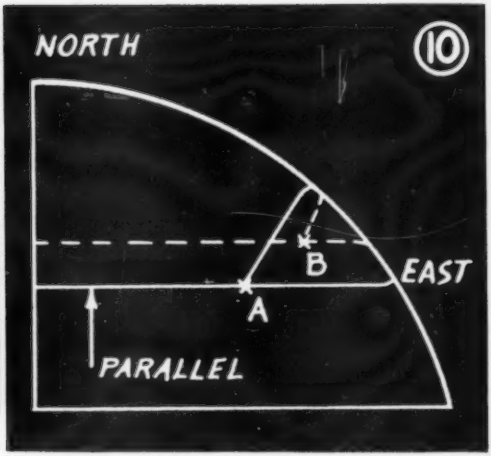


determined by four meridians passing through the country. As is shown in the chart at the top of page 102, 75° West marks the Eastern Standard Time Zone, 90° West—the Central Standard Time Zone, 105° West—Mountain Time, and 120° West—Pacific Time. Eastern War Time is one hour earlier than Eastern Standard Time.

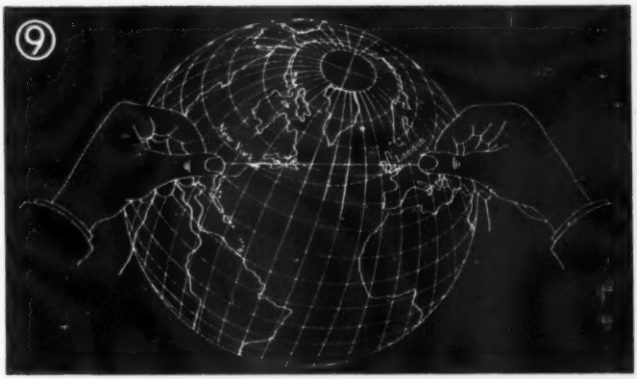
The term *great circle* is one with which we must become familiar because it is most important to navigation. Any circle drawn around the earth which cuts the earth in half is a great circle. As shown in the drawings at the bottom of page 100, the Equator and all meridians are great circles whereas a parallel of latitude is not a great circle. *The shortest distance between any two points on the earth's surface lies on a great circle.* Naturally in our navigation we desire to take the shortest routes possible, and our problem is to determine the great circle track or route. Its solution will lead us directly into our study of course

Some people still believe the earth to be flat, but don't base your map studies on this assumption or you'll wind up behind something round—the 8-ball. Drawing at left portrays favorite argument of flat-earth advocates, who say that people and objects which have vanished mysteriously (like Amelia Earhart) are really stuck on the bottom side, where they were sucked by gravity after falling off the edge. Here we solve three famous "disappearing acts": A—the Dinosaur; B—Dodo bird; C—Judge Crater. The strong man is Atlas.

Measuring great circle track with flexible ruler.



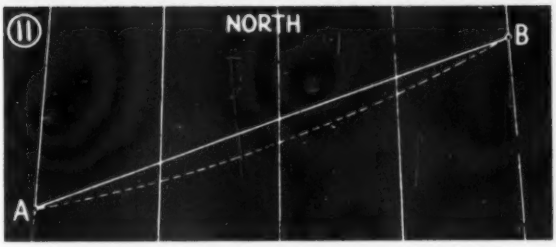
Great circle track is always the shortest route.

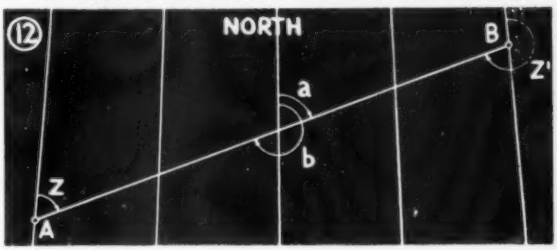


Ships sailing from New York to London follow the great circle track which takes them Northeast, East and then Southeast. This distance is only 3,473 miles compared with rhumb line distance of 3,614 miles.

plotting, and so we will postpone it momentarily while we consider the various types of maps at our disposal.

It is just about as impossible to represent accurately the surface of the earth on a flat map as it is to flatten out the skin of an orange without tearing it. Therefore mathematical projections of the round earth on surfaces which can be flattened out—such as a cylinder, a cone or a flat surface itself—are used. For all our ordinary methods of navigation in the United States only two are important; the cylindrical or *Mercator* and the conic or *Lambert*. To visualize the Mercator projection, let's look at Figs. 4 and 5 on page 103. Let's imagine we have [*Continued on page* 138]



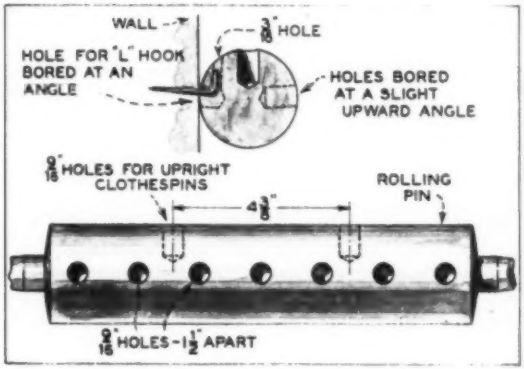


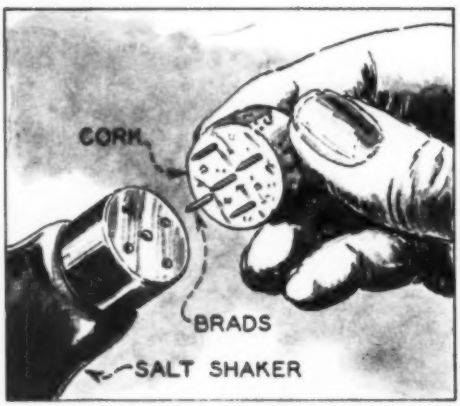
These diagrams show course measurement on Lambert map.

HOUSEHOLD

Kitchen Knife Rack

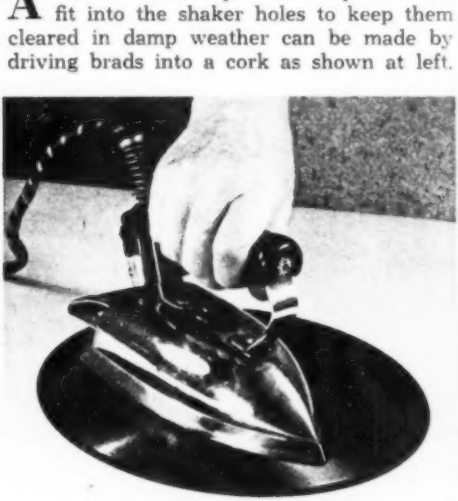
A ROLLING pin and clothespins are combined to make this clever little combination holder, knife rack and utensil hanger for the kitchen. The clothespins with their cutout ends are naturally adapted to hold knives, utensils, etc. Utensils may be hung over as well as in the clothespin pegs. The two upright pegs in the top make a convenient rack for recipe cards.


WALL
3/8" HOLE
HOLE FOR "L" HOOK BORED AT AN ANGLE
HOLES BORED AT A SLIGHT UPWARD ANGLE
9/16" HOLES FOR UPRIGHT CLOTHESPINS
ROLLING PIN
4 3/8"
9/16" HOLES - 1 1/2" APART



← Non-Clog Salt Shaker

A SALT shaker top that has pins which fit into the shaker holes to keep them cleared in damp weather can be made by driving brads into a cork as shown at left.



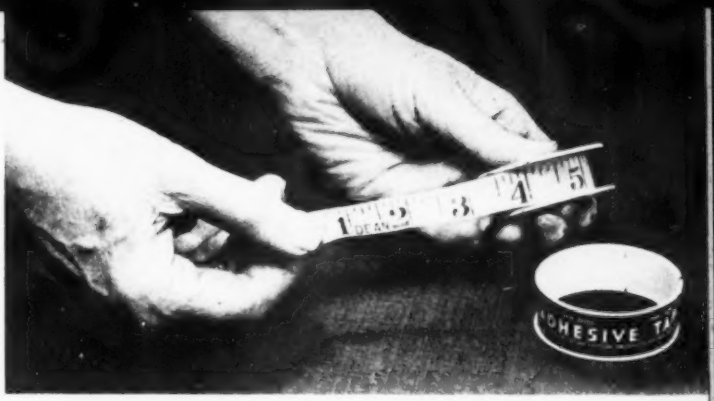
Old Record Cleans Iron →

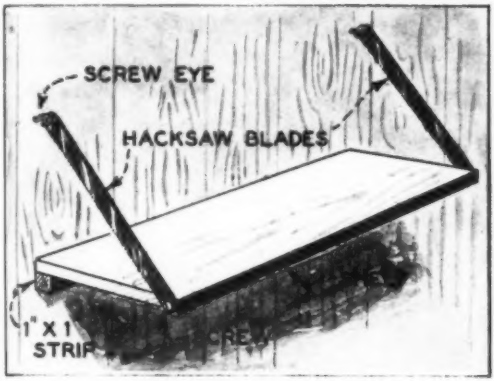
STARCH has a tendency to stick to the iron when ironing starched clothes and soon forms a crust. To prevent this and keep the iron smooth, run the iron over an old phonograph record regularly.

KINKS

Tape Measure

AN EMPTY adhesive tape spool is just the thing on which to wind your tape measure. In this way the tape will be kept neat and clean and ready to use.



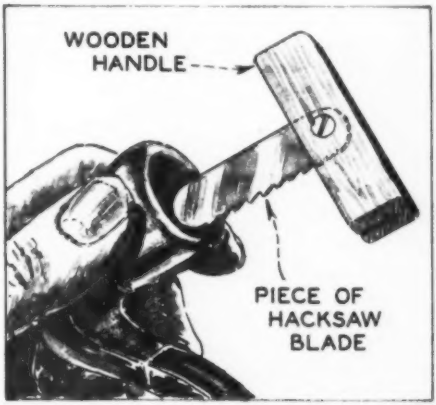


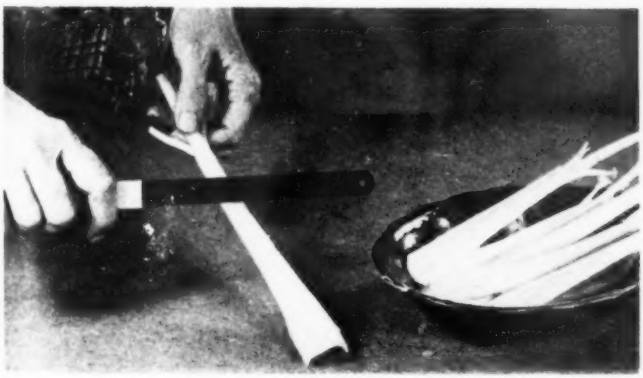
← Simple Shelf Support

WHEN there is a basement or attic shelf to be installed, you will find that a couple of discarded hacksaw blades will provide handy side supports for the shelf. Turn the blades so the teeth face the wall and fasten to the shelf with screws and to the wall with a couple of screw eyes.

Aid To Pipe Smokers →

IF YOU'RE an inveterate pipe smoker, you've doubtless been bothered by the hard crust that forms inside the bowl of your favorite briar. A sharp knife will remove a good part of this crust for you, or you can use one of those patented scrapers. An extremely satisfactory scraper can be made easily by mounting a 2" length of hacksaw blade in a short wooden handle as shown at the right.





Cleaning Celery

CELERY is a healthful food, rich in vitamins, but the stringy backs of those heavy outside stalks are not very edible. Here again an old hacksaw blade can be used to good purpose. Wrap one end of the blade with a few layers of adhesive tape to protect your hand and use it to scrape away the stringy part of the celery.

TOOLS FOR BOAT BUILDING

Simplify and speed up the job by knowing your tools.

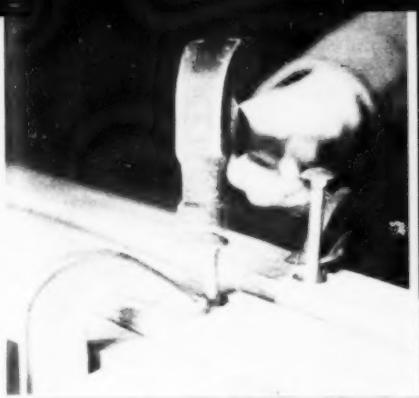
by

J. A. Emmett

JUST what tools you'll need for working on that boat you intend building after the war will depend on its size, on what power tools will be available, and on your chances of borrowing certain others. A good idea is to visualize well in advance what will be required then buy top grade tools, if only one at a time, and take advantage of any local offering of worth-while used ones. For if everything must be bought at once the bill will either run to a tidy percentage of the building cost or you'll be tempted to buy poor grade tools, only to find them a nuisance, particularly if you're building a boat of any size.

Building a cabin boat, for example, will require a fuller assortment than will a smaller

Tools for boat building begin before any wood has been cut. Pencils, rulers, battens and paper start the job in laying down lines and marking patterns, as below and at top. Left, above: A draw knife is very useful in rough trimming parts to shape. Left: Electric drill saves much time in boring for screws.



An ordinary hammer is useful for driving home drift bolts or keel bolts, as above.

Chisels (three or four sizes) and mallet are indispensable for cutting stem and keel rabbets. Keep them sharp.

open one; heavy members of the backbone, rabbeted chine logs, etc., can often be marked, then taken to a mill or professional builder's shop for sawing out. This not only saves building time but avoids a lot of hard work and makes several heavy tools unnecessary.

In most plans for smaller boats dimensions are given for getting out the stem, transom, and temporary building molds. For larger ones, full-size laying down of the lines according to the tables given, either directly on a clear floor or on paper tacked over it, will be necessary, and certain tools required for the work. None of these is expensive. Six, 12, and 18-ft. straightedges can be ordered from your lumber mill—1″x2″ straight sticks of some seasoned wood that is not apt to warp such as spruce, cedar, fir or redwood. A couple of bending battens, $\frac{5}{8}$″ square and several feet longer than the boat, if possible, will be required to lay in curves. A 6-ft. folding rule for measuring—a steel tape will be an advantage but not necessary if the rule is used carefully—a framing square with at least a 2-ft. arm to get lines at right angles to one another where required; a pair of dividers with 10″ legs for accurate spacing of lines now and later; and a common chalkline for striking perfectly straight long lines.

The next step in the work, or the first in building a boat not requiring "laying down," will be to construct temporary building molds. If lumber for these is ordered in

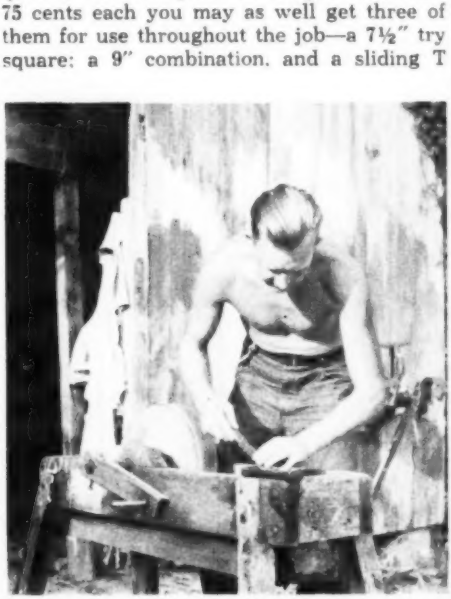
Right: A number of "C" clamps are required in framing up a boat, either round or V bottom. Note how the steam-softened frame is trod into place then clamped to the temporary ribbands until it has a chance to "set."

Left: Wooden blocks are used between plank and clamp to avoid possible marring of plank

Left: An inexpensive screwdriver bit in the brace will turn that screw in fast and solidly. Use ratchet for last few turns. Above: Professional equipment is long ship's auger for boring deep, straight holes. Below: Keep your plane flat and level so edges will test true.

Below: Professional caulker is an artist at his work. Note caulking mallet and irons in can. Amateur can use chisel mallet, one iron. Right: Sharpen tools on grindstone and whetstone.

various correct widths, about the only sawing necessary for a V-bottom boat will be across the grain, requiring a handsaw with crosscut teeth. Don't try to save money on this but buy a reputable make of good quality; a 26″ blade with a straight back and 9-point teeth will be found right for average work. Where a good deal of cutting with the grain must be done, and a power bandsaw is not available, a 5½ point hand ripsaw will cut true and fast—buy it in addition to the crosscut. If sharp curves must be cut a keyhole saw will be required. Your saws must be kept good and sharp; this means filing half a dozen times during the building of a sizeable boat; few of us can do this correctly, but your local mill probably has a man who can. Small carpenter's squares will be required, and as they can be bought for around 75 cents each you may as well get three of them for use throughout the job—a 7½″ try square; a 9″ combination, and a sliding T



bevel. A plane may be required in making the molds, but will be covered later.

Fastening the different parts of the molds together will require a hammer—any fair grade tool will do—and a screwdriver if screws are used. An ordinary screwdriver will serve, but isn't the ideal type for boat building. If a number of comparatively small screws are to be used, as in planking, an automatic or push type screwdriver will not only speed work, but when fitted with a drill bore the lead holes as well. It will not be heavy enough for large screws, and to get those last few turns required to sink the big ones home buy a 15 cent screwdriver bit for use in an ordinary brace, ratcheting the last turns down. A countersink bit, about the same price, will also be required to let screw heads into hardwood.

With the molds completed, a temporary building form or base will probably be set up for a small boat and molds mounted upside down over it. This may be of rough lumber but must be accurate, necessitating a 4-glass level at least 2-ft. long. This will also be used to get molds [*Continued on page* 134]

With assortment of tools shown at right you can build any wooden craft up to 50 ft. or more. You probably won't need them all—one or two from each group should suffice for the average amateur boat builder. 1) Crosscut saw, rip saw, keyhole saw and hack saw. 2) Six different types of planes, left to right: Rabbet plane, curved-face plane, small low-angle plane, two jack planes and bull-nose block plane for hollowing out. Nos. 3 and 4 or 5 are all you'll need. 3) Adzes are handy for hewing out heavy timbers. Here are regular type and curved one for hollowing. 4) Hammers, chisel mallet, wood rasp, calking irons and compass saw. 5) Odd tools for measuring. Squares in background, rules, dividers, chalkline on reel, scratch awl, marking gauge and level. Bevel gauge is also help in getting out frame bevels. 6) Watch your fingers with these! Left to right: Gouge, heavy chisel, drawknife, spoke shave and hatchet, three smaller chisels. Sharp, straight knife should also be included.

Making Microfilm

Microfilm-covered model planes rank among the top notch record holders.

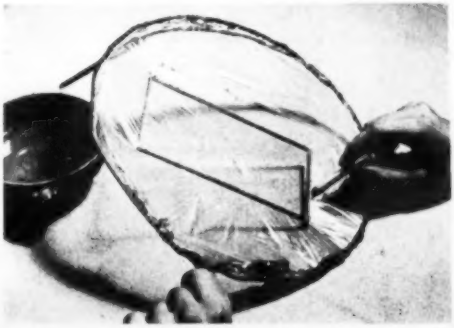
This is the first step in the microfilm making. Pour it from cap of bottle on smooth water. Keep cap close to water.

When microfilm forms, use coat hanger as shown to collect material. Stick hoop under from edge and lift at angle.

Above: Lift the microfilm from the water on the bent coat hanger. Push excess microfilm from center to edge. Drain off water, and hang entire up to dry. Water serves as the cement for holding microfilm to framework of model.

MICROFILM, covering material for the modern high performance model airplane, is easy to make. We show you here, by means of photographs of the actual process, just how it is done. The fluid itself is obtainable in most model supply stores—and your bath tub will serve as your microfilm factory. Light in weight, it makes even the featherweight job lighter, and brings records within reach of even the otherwise sluggish jobs. If you've never tried this new material, here's how to do it. It won't take you long to try out this process, and you'll more than likely be very glad you did.

Set the panels in the microfilm and stick the latter to framework. Trim off excess with cigarette butt.

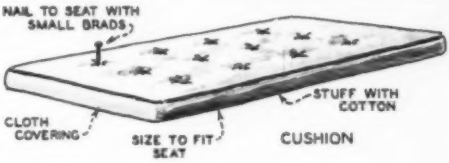


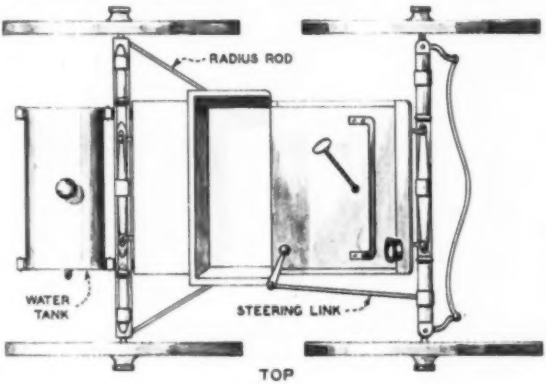
1863 AUSTIN STEAMER

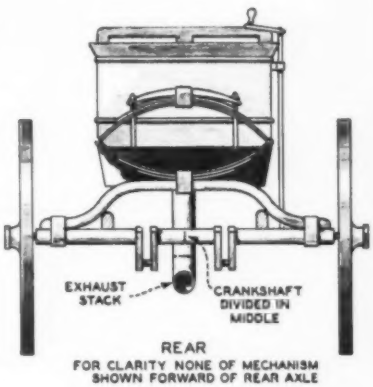
Fourth in MI's series on models of early automobiles.

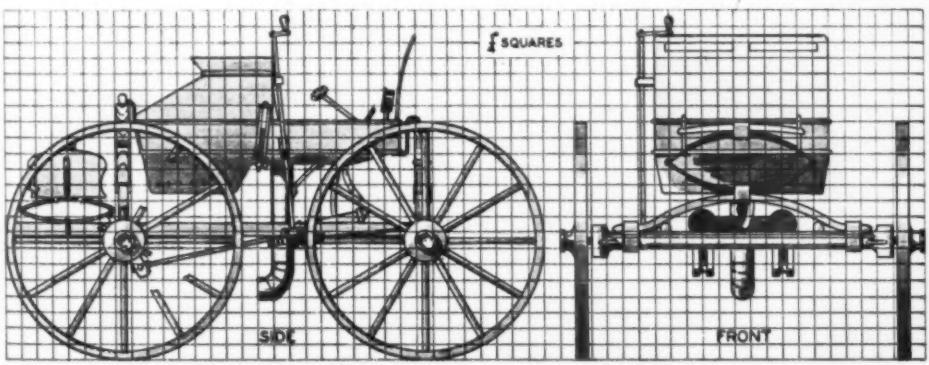
THE present generation of (former) motorists have the impression that the first automobiles were developed around the turn of the century when, in fact, self-propelled road vehicles were built and run as early as 170 years ago. The clumsy Cugnot steam tractor made a trial run in France in 1770, steam coaches did a brisk business in England in the nineteenth century, and an inventive American, Oliver Evans, built several tons of lumber and hardware into an amphibian in 1805 which ran, after a fashion, on the streets and waterways of Phila-

A real pioneer, the Austin steam car was built in England in 1863. Connecting rods drive direct on rear axle, like a British locomotive. Water tank is seen behind seat.







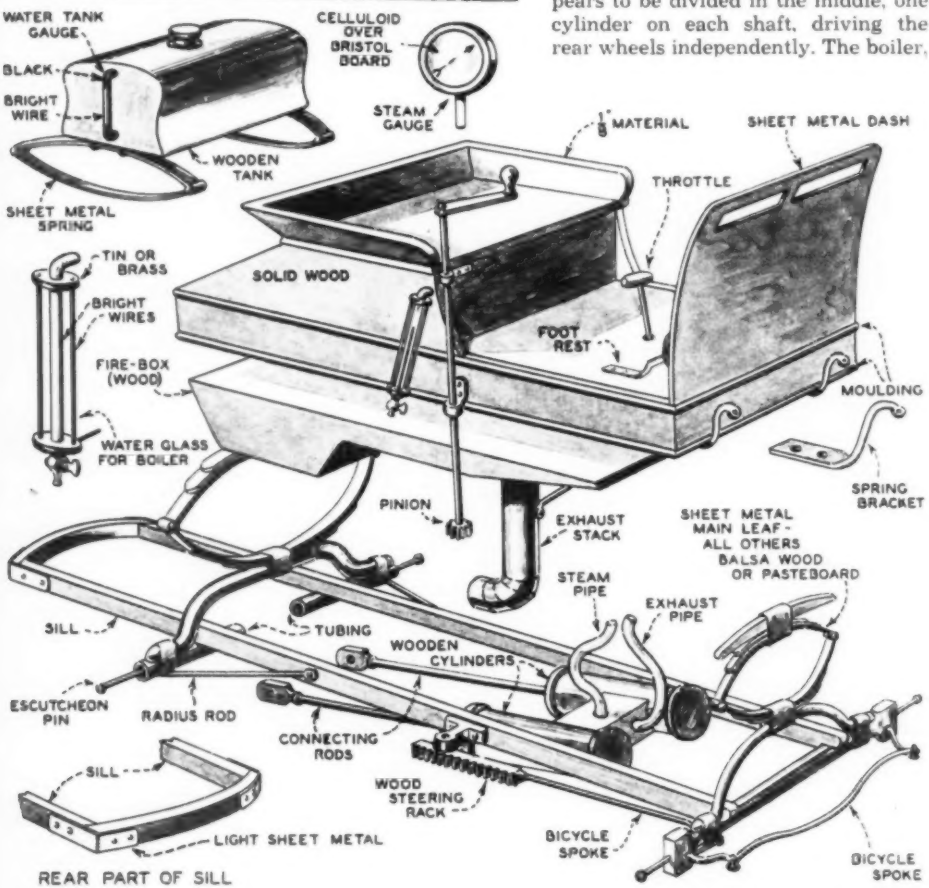


Another early steam car was the Mobile, here photographed on Hollywood Boulevard in 1900. Several thousand of these jittery puff-wagons were sold.

delphia. (See illustration, page 115.)

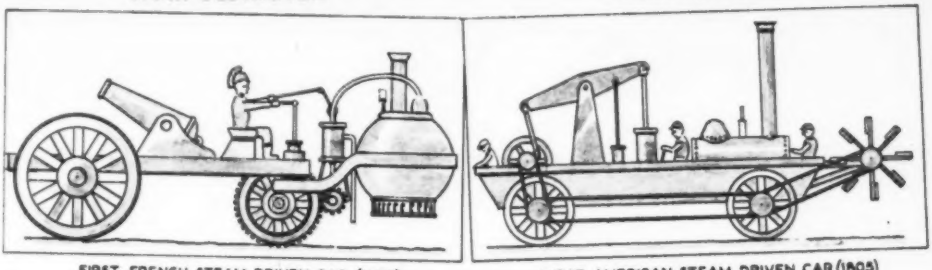
Hence, the Austin steam car described in this article is by no means the first, although it was built in 1863 in England. Quaint as it seems, great credit is due to its designer since he had few precedents to start from, with the exception of a horse-drawn carriage body and wheels and heavy steam engines of the locomotive type. In fact, the mechanical principle is much on the order of the English locomotive in which the cylinders and cranks are between the wheels. This is probably the earliest original model of a self-propelled vehicle preserved today, now on exhibition at the Edison Institute, Dearborn, Mich.

Several interesting features are embodied in this vehicle. There is no differential and the crank shaft appears to be divided in the middle, one cylinder on each shaft, driving the rear wheels independently. The boiler,



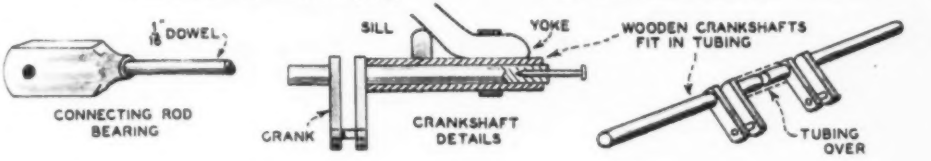
TANK DESTROYER

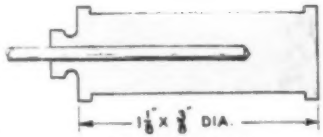
AMPHIBIAN

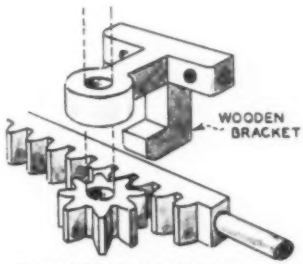


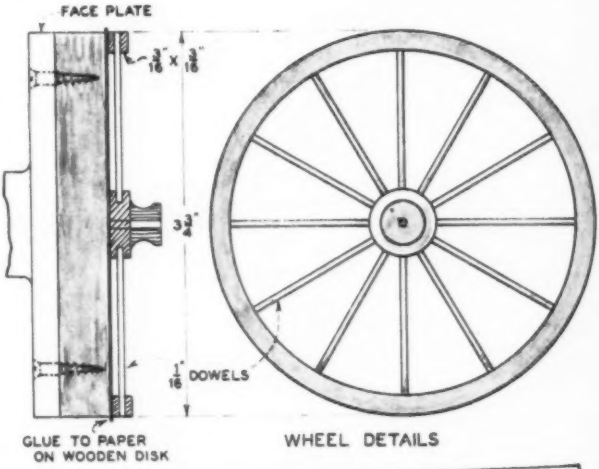
FIRST FRENCH STEAM DRIVEN CAR (1770)

FIRST AMERICAN STEAM DRIVEN CAR (1805)









located under the seat and floor boards, is obviously fired with coal, and the draft forced down through the exhaust stack by the spent steam from the cylinders. The stack, by the way, looks very much like an inverted stove pipe. Inasmuch as there is no cross-head or joint in the piston rods, the cylinders must be of the oscillating type.

Compared with the sturdy steering gear of modern cars capable of 90 m.p.h., this frail rack-and-pinion arrangement does not seem very

[*Continued on page* 146]

Carriages without horses shall go,
And accidents fill the world with woe.

Old Mother Shipton has been vindicated insofar as this part of her prophecy is concerned. Of course, it is now generally believed that the verse, of which the foregoing is only a part, was a hoax to the extent that the predictions were circulated after most of the predicted things had come to pass.

But it must be admitted that the author of the introductory lines anticipated present-day traffic problems. The comic sketch here shown appeared in 1828 shortly after the advent of steam carriages which was nearly four centuries after Mother Shipton is supposed to have lived. The artist was himself something of a seer because he attempted to show how the streets would some day be clogged by horseless carriages.

INDEXED TOOL-POST TURRET

Turret set up for machining duplicate parts on 14" lathe. It's attached to slotted casting bolted in turn to lathe cross-slide.

by
Walter E. Burton

The turret block shown above was machined from cast steel. A hole is being tapped for one of the bolts that holds the chip guard or "skirt."

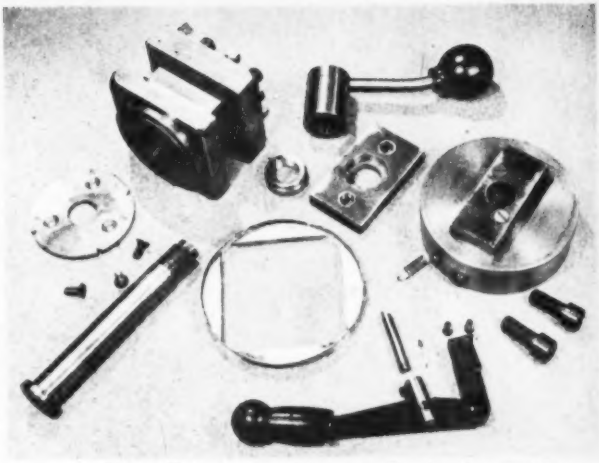
ONE of the most useful accessories for a lathe that is to be used in making duplicate parts as well as for ordinary turning is a tool-post turret. Often the making of such a turret is the first step in converting a lathe for war production. Here is a turret having a simple, positive indexing mechanism that is superior to many of the spring-plunger and fixed-pin arrangements so often used.

The tool block of this turret does not lift from its base while shifting from one tool to the next. This keeps chips from getting beneath the block. A sheet-metal skirt encircling the tool block (Fig. 8) further protects the joint between block and base against chips.

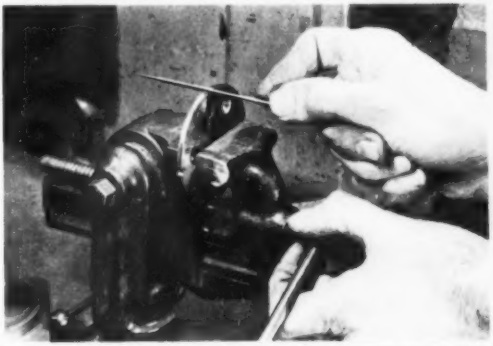
The indexing mechanism consists of a notched plate fastened to the bottom of the block, and a movable steel pin (Fig. 3A) that engages the notches. A hand lever controls the pin, and a spring attached to the lever and base block holds it against the disk. The pin rides in a hardened steel bushing. The drawings and photographs show a round pin, which has proved satisfactory over a period of months of use. It might be better, however, to provide for adjustment of the clearance

between the pin and the hole through which it slides. One way would be to use a square pin and install adjustable gibs alongside it. Make the tolerance between pin and bushing as close as possible. A simple way is to use a fine lapping powder, after the parts are hardened. Note that the pin and notches are positioned so that, as the nut on the hold-down bolt is tightened, pressure is exerted against the flat surfaces of pin and notch by any dragging force that may tend to rotate the turret. The index plate shown has four notches; you can add intermediate ones if desired, so the turret can be indexed at angular positions. The index plate should be hardened for wear, although a plate machined from cold-rolled or similar steel and used without hardening will give a lot of service.

The turret illustrated is mounted on a special block that takes the place of the compound slide on the carriage of a 14" lathe. This block, bolted to the cross slide, has T slots for the turret and back cut-off tools. A more flexible arrangement, however, is to make the turrets so it



Above: Various parts of the turret. See drawings for identifications. Below: Filing index pin notches in the index plate with triangular file. Notches are 90 degrees apart.



Drawing below gives dimensions and details of turret top and index plate (see parts photo above).

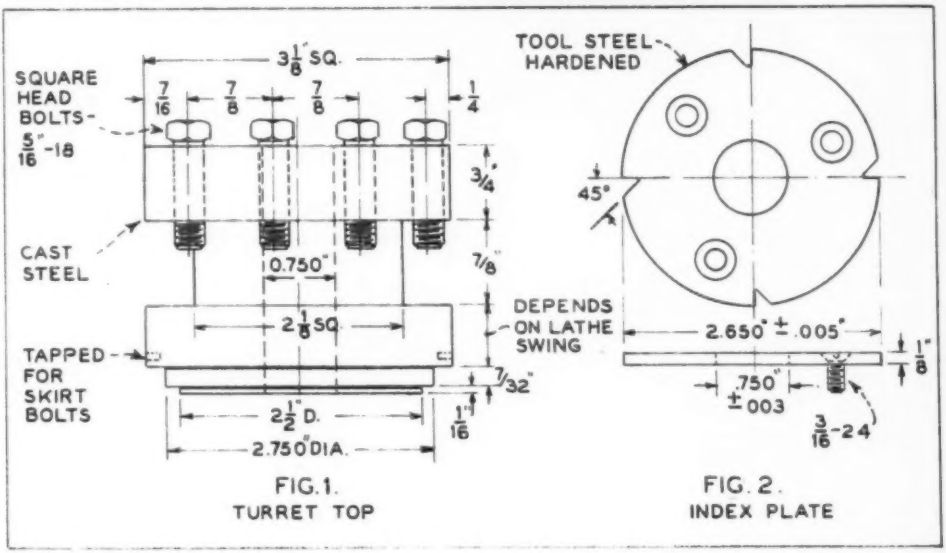
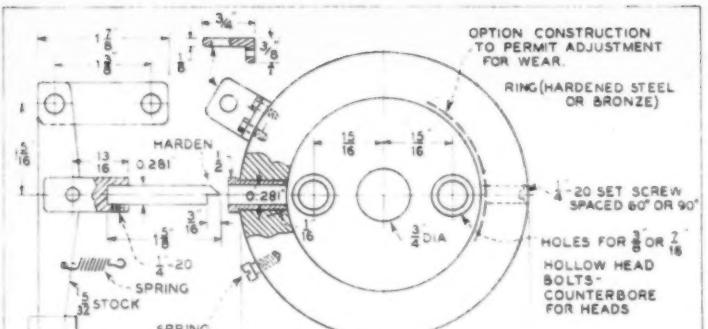
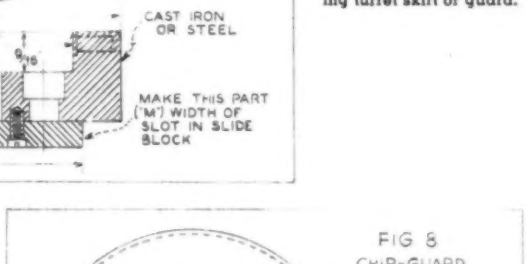


FIG. 1. TURRET TOP

FIG. 2. INDEX PLATE



Left: Base and index pin mechanism should be made to these measurements. Below: Any thin scrap sheet metal can be used for the protecting turret skirt or guard.



can be mounted in the regular tool post slot. Exact height of the turret block will depend on the dimensions of the lathe; that is, on the distance between the top of the T slot and the lathe centers. Points of tool bits held in the slots should be approximately in line with the centers. Final adjustment is accomplished by the use of shim strips beneath the bits.

The fit between the turret block and its base should be as snug as you can make it, for any looseness here will affect the accuracy of the tool settings. Use lapping compound in fitting the joint. Take-up bolts might be added to the base, their ends pressing against the base of the turret block (at the 2.750" diameter) or against an inserted ring which in turn presses against the block, to eliminate looseness resulting from wear or poor fitting.

Construction of the turret is shown by the drawings and photographs. Referring to the drawings, the various parts include: Fig. 1—Turret block after machining. Cast steel is a satisfactory material; or the blank can be built up by welding pieces of machine steel together.

Fig. 2—Index plate as seen from bottom. Note shape of notches, the little space at the bottom being for the purpose of catching dirt that otherwise might prevent the index pin from seating.

Fig. 3—Details of base piece. The outside diameter (4⅛ inch) may be varied to fit the tool post or cross-slide block used.

Fig. 3A—This shows the index-pin mechanism. The lever used on the model illustrated was salvaged from an automobile junk heap; it originally controlled the cowl ventilator.

Fig. 4—Nut-and-knob arrangement used on hold-down bolt.

Fig. 5—The hold-down bolt. Its length will depend on the height of the turret, depth of the T slot, etc. Also, the diameter of the head will be governed by width of T slot.

Fig. 6—Washer used between nut and turret block.

Fig. 7—Plate that enters T slot of carriage, its width depending on width of the slot. The bolt head rests in recess of center hole.

Fig. 8—Skirt or chip guard encircling turret block and base.

If properly made, this turret will give long and accurate service. The model illustrated holds its settings faithfully, and never has been jammed by chips. For large lathes, the block size can be increased, say to a diameter of 4". Machining operations are conventional. The tool-bit slots may be cut with a mill or shaper. The index plate should be turned to final diameter after fastening to the block; it is a good idea to have the plate ready and machine it at the same time the bottom diameters of the block are turned.

In using the turret, use the lever to force the pin into the index-plate notches while the hold-down nut is being tightened. Usually the spring cannot be depended upon to exert enough pressure.

CLEANING YOUR LATHE

Perhaps the most important single factor in long life and accuracy for your metal lathe is cleanliness. Chips, dust and grime allowed to accumulate in and around the lathe will cause friction and abrasion with consequent wearing of various parts. Use an ordinary paint brush for cleaning carriage, bed, gear teeth and threads after each using. A vacuum cleaner is also handy for this. Once a week clean the whole tool thoroughly with kerosene or carbon tetrachloride, then lubricate.

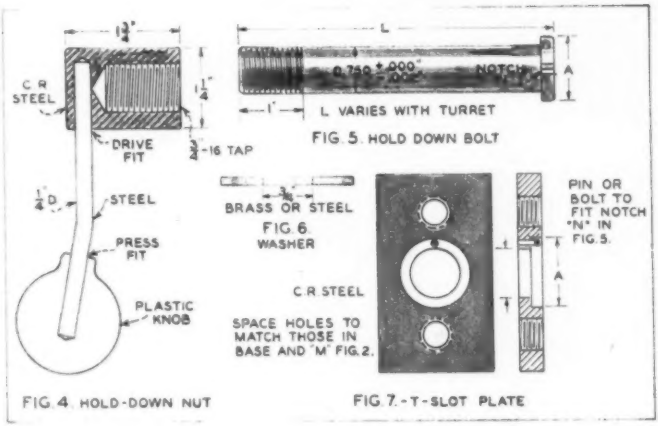


FIG. 4. HOLD-DOWN NUT

FIG. 5. HOLD DOWN BOLT

FIG. 7.-T-SLOT PLATE

Top: Two hollow head bolts engaging a plate inside the T slot secure the turret base to the carriage so it won't move when the hold-down nut is loosened. This is more rigid than usual single bolt method, but turret block must be lifted in order to loosen the hollow head bolts. Above: This shows underside construction of turret block, etc. Note skirt around block; its bent-down edge encircles the base. (Offset surface of base is not necessary, but was made on original in order to ease machining.) Left: Construction details (see text).

Front view of cabinet with doors open shows arrangement of the shelves and storage space.

CABINET LATHE STAND

IF YOU are an enthusiastic woodworker and plan to add a wood lathe or large saw to your equipment. and especially if your workshop is in the basement. you'll find this platform and cabinet stand well worth while. The platform will furnish a level base on the most uneven concrete floor and the cabinet will hold the tools and fittings for your apparatus. This is how the author constructed them. You can vary the plans to meet your own situation. of course.

For the platform he laid on edge seven 2x4's spaced about

Construction details at right.

16″ apart. At each end a 1x4, 8′ long was nailed to hold them in place. At 16″ intervals 1x4's were toenailed across the 2x4's, forming a honeycomb foundation. This frame was carefully leveled and wet concrete placed under each 2x4 to fill all hollows in the concrete floor. The concrete served both to give the 2x4's rigid support and to prevent them from moving.

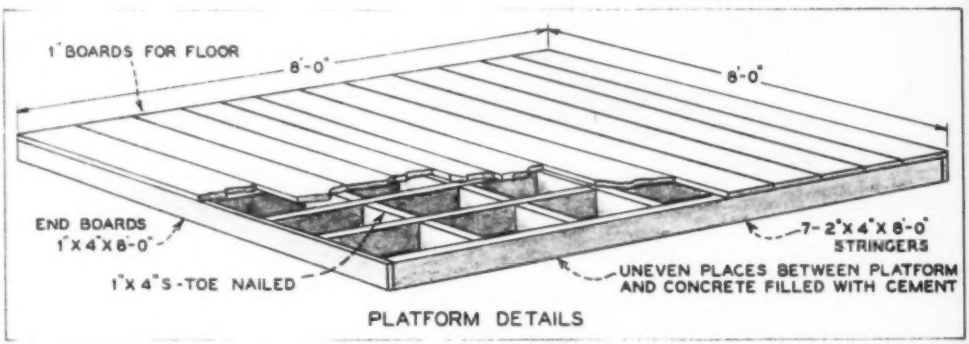
Matched boards ¾″x8″x8′ were nailed to the frame to form a floor. This platform served to support both an 8″ saw and a wood lathe with a 4′ bed and a 9″ swing, both belted to the same motor. No shafting was used.

The cabinet was built with a frame of 2x4's to which ¾″ plywood was screwed. It is 32¾″ high, 18″ wide and 4′ long on the outside. The top is 20″x49″, having a 1″ overhang all around except on the pulley end of the lathe. The material required consisted of four 2x4's, 8′ long, and two 1x4's 8′ long and two 4′x7′ sheets of ¾″ plywood.

The top of the frame has two 2x4 crosspieces at the top in addition to the end crosspieces. The end crosspieces are widened with 1x4's so that the screws holding the lathe to the top will extend into them. All screws holding the lathe, therefore, go through the ¾″ top and into 2x4's. There is a center upright at the front and a center crosspiece at the bottom of the frame. The two doors are 19½″ by 26″. There is a plywood bottom fastened to the bottom of the frame and two shelves are placed above it. These make three storage compartments. Spikes were used for nailing the frame together, and ½″ No. 10 wood screws for fastening the plywood to the frame. Two sets of hinges and two latches complete the hardware required. The cabinet was fastened to the floor by three 4″ angles at the front and three at the [*Continued on page* 140]

Diagonal view of cabinet stand is shown above. Notice the light bracket, reflector and support.

Back view of the stand above shows how both the lathe and saw can be hooked up to the same motor.

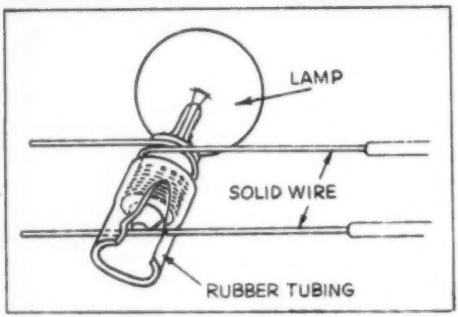


This platform will furnish a rigid base for the stand. Fill uneven spaces in floor with concrete.

SHOP KINKS

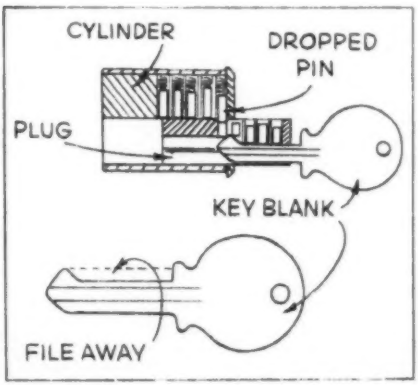
To Release A Jammed Lock →

IF A top pin of a cylinder lock drops into the wrong hole when you are removing the plug to replace worn pins, raise it to the neutral position with a key blank filed as at right. Insert to neutral position. Slight twist will release plug.



Two Discs For Grinder

IF TWO sandpaper discs, placed back to back, are used at the same time in a hand grinder, they will not only last longer but will also be more efficient, providing a sanding surface on the inner side that will reach otherwise inaccessible parts of your work.



← Emergency Compressor

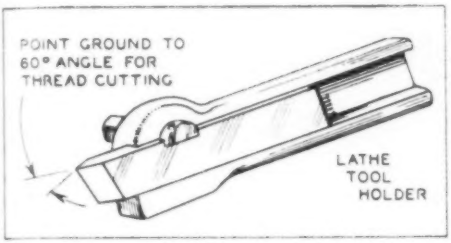
WHEN power fails, users of air brushes and spray guns can use a hand sprayer connected to compressor line as at left. Insert a tee in the line for connection.

Improvised Bulb Sockets

IMPROVISED sockets for test lamps can be made easily from rubber tubing in the manner shown. They will hold either screw-base or bayonet-base lamps. Stiff wire is best.

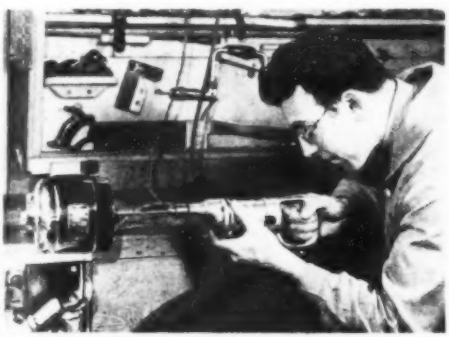
Handy Change Box

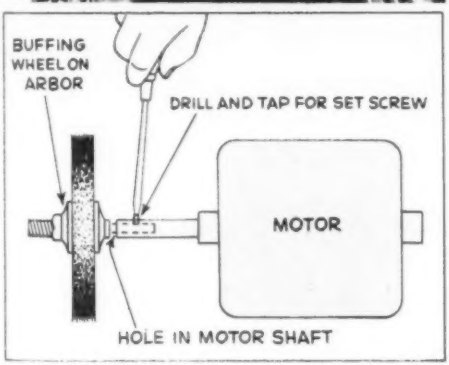
THE small change box at the right is very handy around the home or in a small business. It is made of ¼" box boards that have been well smoothed off and sanded. The coin blocks are sawed out in a curved shape as shown and partitions are made of thin wood. These parts are glued in place. The lid knob is a piece of small brass pipe ¾" long soldered to a wood screw.

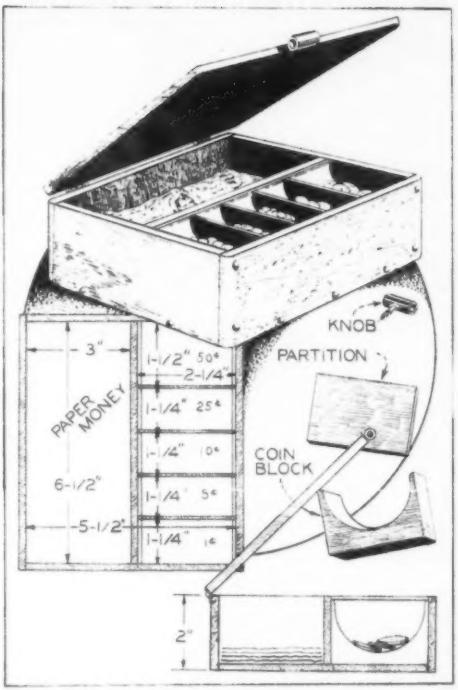


Tool For V-Threads

ONE of the very best tools for V-threads is a common lathe parting tool ground to a 60° point as above. Set your compound to feed in this tool at right angles to the work.

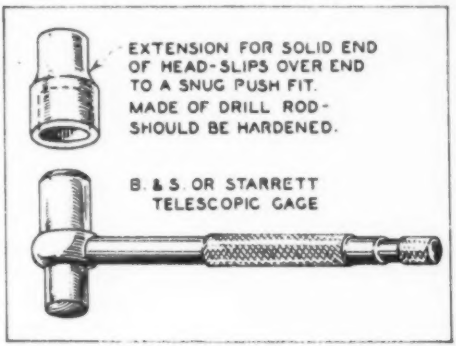






← Buffing Wheel Arbor

A BUFFING-WHEEL arbor can be attached directly to a motor shaft if a ¼" hole is drilled lengthwise in the end of the shaft and the arbor locked in place with a set screw as in photo and drawing at left.



Extensions For Gages

IF YOU haven't a full set of telescopic gages, two or three of them can be made more useful by turning up simple extension tips from hardened drill rod as above.

IDEAS FOR SERVICE MEN

Private Al Gardner, of Drew Field, Tampa, Fla., writes to say that he has an A-1 simple method of keeping his utensils grease-free when out on maneuvers. He just carries along a box of Kleenex, with which he can swab his mess kit clean as a whistle, wash water or no wash water.

Here's an idea from Edward Moran of Riverdale, New York that comes under the head of plain, practical advice rather than "kink." He suggests that men going to a boot camp or training station would do well to buy a padlock with a long shank (like a bicycle lock) for use on their duffle or sea bags. Later they can use the lock to prevent things from being "borrowed" from their lockers.

Sergeant J. Donahue, who is in an Ontario hospital says, "Two very useful articles for the soldier's kit are black and tan wax crayons. Use them for covering tell-tale scuffs and nicks in boots, leather equipment and gun stocks. Just before parade or inspection time they are worth their weight in gold."

Next is a letter from Albert Massari, S 1/c, U. S. Navy. Quoting Al, "I am enclosing the following, which should be a help to some of my shipmates: After washing white 'color' stripes with an old toothbrush and soap, rinse the washed part and blow through the back side. You will blow out a whole mess of old suds and your stripes will come out cleaner.

"Another trick I learned from an old C.P.O. is for men in the tropics who wish to mark their names on their clothes. Secure an alligator pear, prick a pin into the large center stone and mark on gear. This will never come out, and will appear even brighter after material has been washed."

PFC William B. Hopkins, who spends his business hours fooling around with ack-ack at Newport, R. I., shoots this bit of breeze at us:

"In your May issue, 'Ideas for Service Men,' I noticed a soldier cleaning his gun with a toothbrush. Now, I use the same idea, but after finishing with the toothbrush you must wipe off the gun with something, usually a rag. I find the best thing for this purpose is a *baby diaper,* as it is soft and leaves no

lint for the inspecting officer to find.

"Also a word about the article on cleaning brass buttons. I am sure we would appreciate knowing about a quick and effective substance with which to clean them."

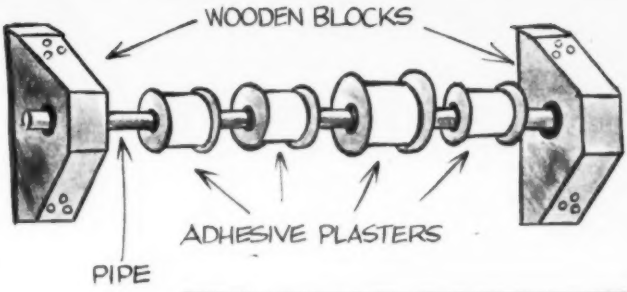
[All we can say is, now we've heard of everything. Men, if you've run out of diapers have the little woman send you some of Junior's. We *can* help with the button cleaning problem though, as you will see by reading on.—*Ed.*]

Just by coincidence we have the answer to the above question right at hand, via PFC Alex Pittner, Bingham City, Utah, who says that the best thing for cleaning brass blouse buttons is plain old ammonia and water. Alex maintains that this is far superior to metal polish, and will keep the buttons from tarnishing for a much longer time. Applying a little clear nail polish afterward (see June MI, page 123) will keep them shiny for practically the duration.

Pvt. T. D. Thurman sends the following suggestion from Ft. McClellan, Ala.

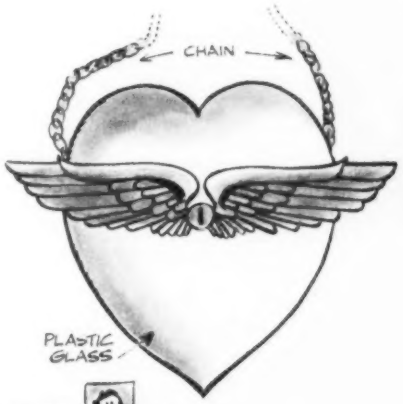
"In dispensaries and hospitals, where large quantities of adhesive plaster are used, a spool holder can be made from two wooden blocks and a pipe nailed to the wall as illustrated. This makes the plaster easier to handle when unrolling it."

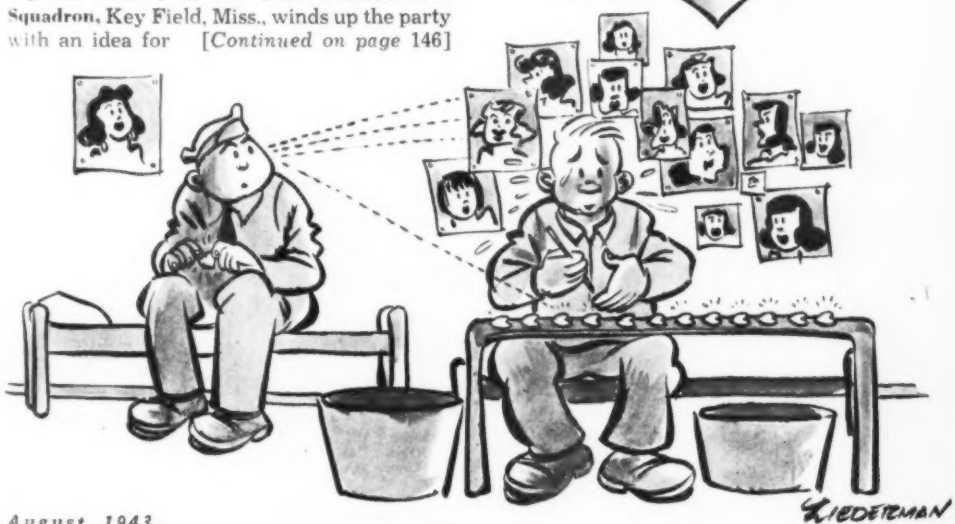
J. A. Adams, of the 56th Bombardment Squadron, Key Field, Miss., winds up the party with an idea for [*Continued on page* 146]



SERVICE MEN, ATTENTION!

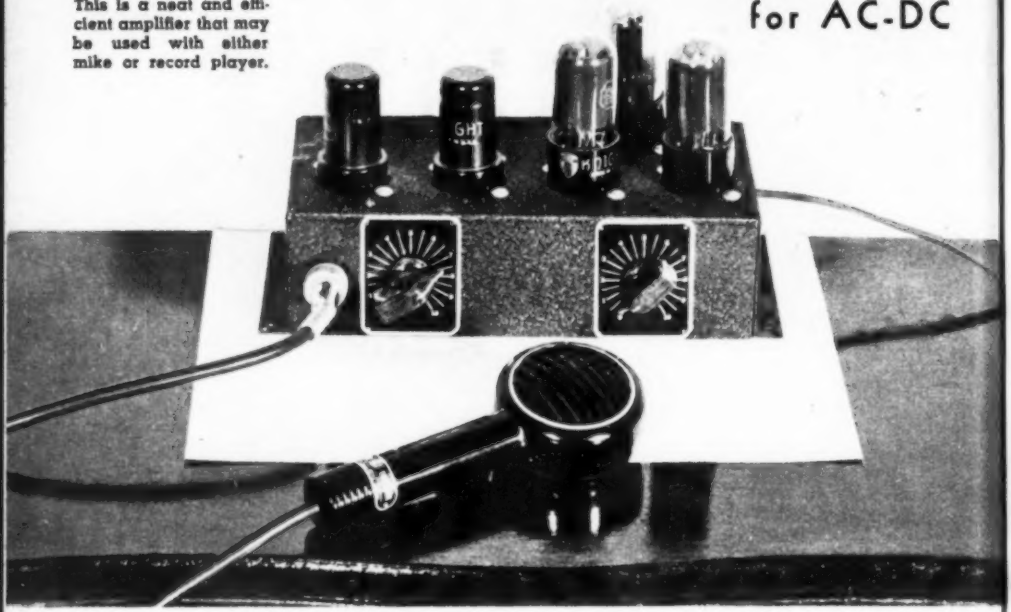
This is your department, and if you like it enough to want to make it better, you can. It's all up to you! Send in your ideas—anything you think may help your buddies in the Army, Navy or Marines. You'll be helping yourself too, because MECHANIX ILLUSTRATED pays from $2.50 up for material used. Address "Ideas for Service Men," MECHANIX ILLUSTRATED, 1501 Broadway, New York, 18, N. Y.





Four Watt P. A. Amplifier for AC-DC

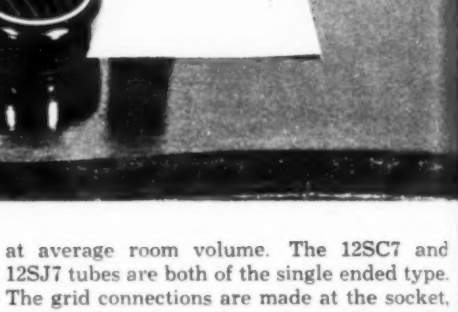
This is a neat and efficient amplifier that may be used with either mike or record player.



THERE are so many uses around the shop and home for a small, low power, high gain amplifier that we couldn't begin to list them all. With this little job you can reproduce records, use a microphone, or do both at the same time, if you please. It is the ideal amplifier for a recording unit, since the 4 watt output is ample for this purpose, and you have two channels separately controlled and independent of each other.

You will find this unit economical, small and light weight. The amplifier chassis complete with tubes weighs less than two and a half pounds. The tube filaments are connected in series as in conventional AC-DC circuits. The total filament voltages of the tubes is 129 volts, but this is not far enough off to affect operation even at 110 volts. The chassis is not connected to the line at any point, so there is no danger of a possible short between this and ground. Since the microphone does connect to one side of the line, we used a completely shielded hand mike. The one we used was a Shure Bros. type 717A, which never gave any trouble in this respect.

The output of a pair of 35L6GT tubes is ample to operate a six- or eight-inch speaker at average room volume. The 12SC7 and 12SJ7 tubes are both of the single ended type. The grid connections are made at the socket, so all such leads are short, thus reducing the possibility of hum or feedback. No cathode by-pass condensers are used. The cathode of the 12SJ7 is run directly to ground and grid bias is maintained by contact potential through the 5 meg grid resistor. Since the other two stages are operated in push-pull, cathode by-passing is not necessary. Plenty



Bottom view of chassis, showing few parts employed. Six- or eight-inch dynamic loud speaker may be used.

Parts List For 4 Watt Amplifier

3—.05 mfd. 400 volt condensers	Knight 10-460
1—.5 mfd. 200 volt condenser	Knight 10-433
3—.01 mfd. 400-volt condensers	Knight 10-436
2—.01 mfd. 600 volt condensers	Knight 10-486
2—40 mfd. 150 volt condensers	Knight 10-236
1—20 mfd. 150 volt condensers	Knight 10-234
9—½ meg ½ watt resistors	Knight 1-820
1—1 meg ½ watt resistor	Knight 1-820
3—¼ meg ½ watt resistors	Knight 1-820
1—5 meg ½ watt resistor	Knight 1-820
1—½ meg volume control	Knight 30-409
1—½ meg volume control with switch	Knight 30-434
1—4,000 ohm ½ watt resistor	Knight 1-820
1—100,000 ohm ½ watt resistor	Knight 1-820
1—75 ohm 3 watt resistor	Knight 1-860
1—50,000 ohm 1 watt resistor	Knight 1-840
1—6" PM speaker	Knight 81-602
1—Output transformer	Knight 62-300
1—Choke 15 hy @ 40 mills	Knight 62-011
1—Chassis 2¼"x4"x8"	Knight Special
5—Octal wafer sockets	Knight 40-228
1—4 prong wafer socket	Knight 40-224
1—4 prong speaker plug	Knight 40-504
1—Twin jack	Knight 41-377
1—Microphone chassis connector	Knight 41-965
2—Bar knobs 1¼"	Knight 55-074
2—Dial plates	Knight 55-172
Miscellaneous hardware, wire, etc.	

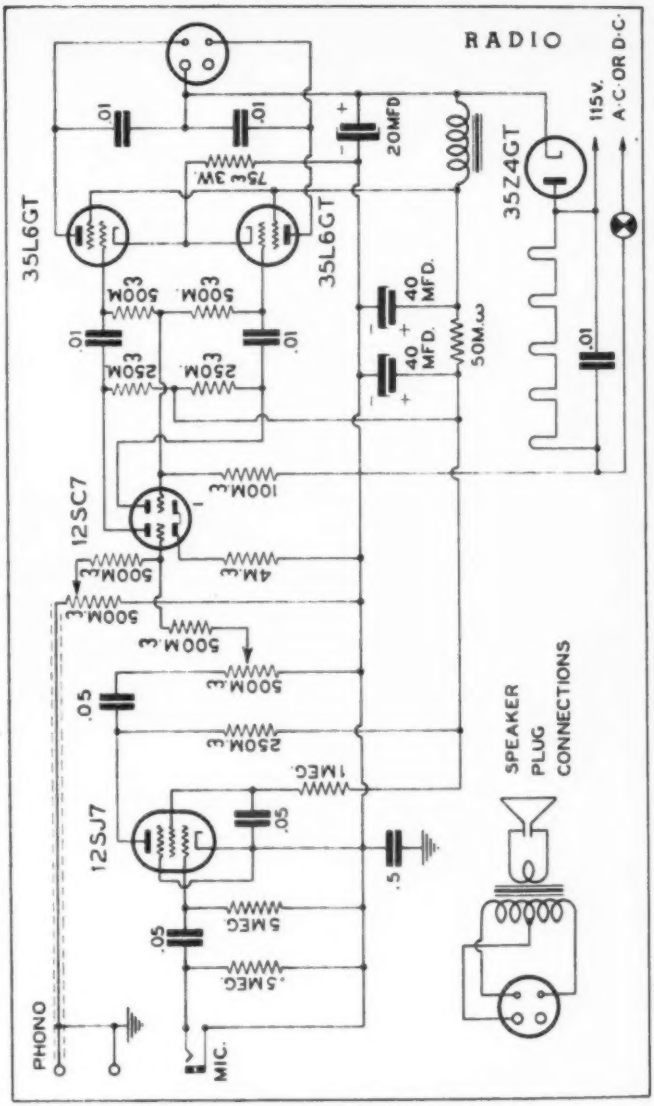


Diagram of the amplifier giving parts values, etc.

of filtering is used in the high voltage circuit to keep the hum down.

Since the common ground is connected to one side of the line voltage supply, it is never connected to the chassis for obvious safety reasons. All returns in one stage should be made at one point, to prevent unwanted coupling between stages. If any hum does come through, a little juggling of these returns will usually clear the matter up.

The mixer circuit is very simple, and while there may be a slight inter action when both controls are operated at the same time, it is hardly noticeable if you did not know it. The phase inverter is the balanced type and is not a bit tricky.

The chassis is 2¼"x4"x8" and can be purchased ready made and punched at your radio jobber. The first thing, of course, is to mount the sockets, mike and phonograph inputs and volume controls. Before mounting the choke and filter condensers, as much wiring should be done as possible, since these units cover some of the sockets and the terminals are inaccessible.

Insulated tie lugs should be used for making the ground connections at each stage, and then these points are connected together. The tube filaments are wired in series with the 12SJ7 on the ground side of the line, followed by the 12SC7, the two 35L6GT's and the 35Z4GT. This [*Continued on page* 144]

BILL BILDIT REBUILDS

OH DEAR! LET'S HURRY OR WE'LL BE LATE FOR THE PICNIC.
MY BATTERY IS DEAD... AND I HAD IT CHARGED ONLY LAST NIGHT. NO PICNIC FOR US!
B-R-R-R-UMPH!
1
CAN'T BUY A NEW ONE SO I'LL REPAIR THE OLD ONE! I'LL MELT THE SEALING COMPOUND WITH A BLOWTORCH, SCOOP IT UP WITH A SCREWDRIVER AND KEEP IT IN A CAN.
2
I'LL LIFT IT OUT THIS WAY AND SET IT ON THOSE NEWSPAPERS SO I WON'T GET ANY ACID AROUND.
3
SHE WON'T MISS THIS BROKEN PLATE. REPLACING THE DAMAGED PLATE SEPARATORS WILL FINISH THE JOB. I CAN GET NEW ONES AT THE GARAGE.
4

A STORAGE BATTERY

NOW TO GET RID OF THE SEDIMENT. THE GLASSES WILL PROTECT MY EYES AND THE BICARB WILL COME IN HANDY IF I GET SOME ACID ON MY HANDS.
BICARBON OF SODA
5

WELL, BILL, THIS IS ONE PICNIC WE WON'T MISS! I HAVE A SMART HUSBAND.
OH, IT WASN'T SUCH A HARD JOB! ANYTHING TO KEEP PEACE IN THE FAMILY.
LUNDBERG
8

HANDY HOLDERS FOR YARN

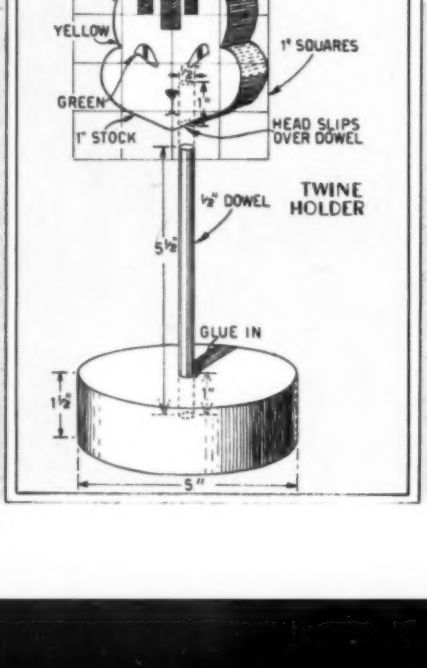
and twine

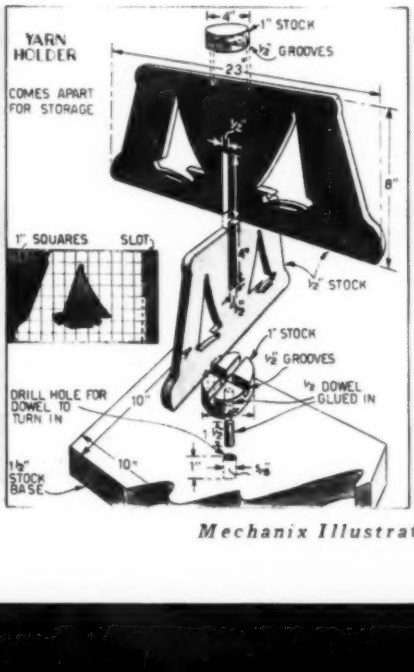
These two household aids are simply made and very useful. If you do much knitting the yarn holder will really speed up the winding job.

THE portable yarn holder will be welcomed by women who are knitting for the boys overseas. It holds a skein of yarn and turns easily for winding or knitting and may be quickly assembled or taken apart for storage. Cut the two cross pieces from ½" stock, saw a ½" slot half way up from the bottom of one and half way down from the top of the other; jigsaw out the ship design on each side of each section and slip the two pieces together. Cut a ½" disk 4" in diameter and cross it with two grooves ½"x½". Set this section over the top. Next cut a similar disk and glue a ½" dowel 1½" long into the smooth or under side. Set this under the two cross pieces. Cut the base 10"x10" from 1½" stock and drill a ⅝" hole 1" deep in the center. Put the dowel glued in the lower disk in this hole and your holder is ready. Soap the dowel so it will turn easily.

The little wooden kitten with his head stuck through a ball of twine is

[*Continued on page* 140]





Flying The World's Fastest Bomber

[*Continued from page 52*]

several years. Several firms have devised manufacturing systems whereby sheets of wooden veneer are moulded over form structures and under great heat and pressure. In that way wings and fuselages may be cheaply and efficiently built by workers with but ordinary carpenter's skill.

In the case of the Mosquito, however, the De Havilland experts had a wider vision of the potentialities of the all-wood plane. Where others had concentrated on "flivver planes" and cheaply produced light trainers, the British engineers worked on the possibility of building twin-engined bombers that could be used in actual war. So they collected a staff of piano makers, cabinet makers, skilled carpenters, joiners and other experts in the woodworking trades to man their production line. Over massive forms, sheets of specially-prepared plywood and balsa are spread. Over this a flexible steel blanket is wrapped and glue is forced between the sheets of plywood. Then the metal is tightened up and the plywood sheets are "cold-set" over the moulds. No heat is applied, for none is needed. Halves of fuselages thus formed are then carefully fitted together. The wings are manufactured in much the same way.

Some metal fittings are necessary, of course, but many load-bearing members are selected from the giant hardwoods of the Canadian forests.

But its wood construction does not fully explain why the Mosquito is so fast. Aviation men, agreeing that the plane structure itself may be extremely light, insist that there must be other factors that contribute to the Mosquito's unusual performance.

The De Havilland bomber is powered with two American-built Rolls-Royce Merlin engines which are rated at 1,260 h.p. These engines are of the in-line type and thus can be efficiently streamlined into wing nacelles. For further streamlining, the Mosquito is finished off with no less than 32 coats of aircraft lacquer, so that nowhere is there the least speed-killing obtrusion, such as appear on the surfaces of all-metal planes where sometimes as many as 50,000 rivet-heads protrude to dampen speed.

But the De Havilland engineers may have stumbled upon a source of speed-producing energy that has all too long been ignored. While there has been no official confirmation of this, some experts have pointed out that through an ingenious arrangement which traps the exhaust gases of the motors, a primary form of jet-propulsion is produced. It will be noted from an inspection of the Mosquito photograph that each exhaust manifold is shielded by a tubular device. Inside this, it has been explained, the hot exhaust manifold heats incoming air, which upon this expansion attempts to force itself out of the slitted apertures at the rear end of the tube. In addition, there are several other features which may justify the belief that the Mosquito may be taking a lead from the proponents of the rocket ship.

When De Havilland engineers were questioned about this, they seemed uncertain of the answer. One explained that the tubular device was nothing more than a flash-dampener for night flying.

"But the Mosquito isn't fitted for night flying," a Toronto newspaperman pointed out, "your own trade prospectus states that it is a bomber-reconnaissance plane—an out-and-out daytime operating machine. Besides, these are nothing like the flash-dampeners we have seen on other aircraft!"

"I'm sorry," the engineer said, smiling. "We'll have to call them flash-dampeners for the time being."

Pilots of Mosquitos are especially trained, as one authority has put it, to fly "as low as they like and as fast as they can." Flying often as low as 25 feet off the ground, at more than 400 miles an hour, they can thumb their noses at enemy anti-aircraft defenses and fighter planes alike, for neither can maneuver freely enough to touch them at such a height and speed. This had led them to develop to a high degree of effectiveness their own technique of low-level bombing, reported to be even more accurate than dive-bombing. One pilot made it sound very simple when he said:

"You just get to your target, lay your eggs, and go."

It is a little more difficult than that. Mosquito pilots are trained, for example, to fly between obstacles. The gap is progressively narrowed until the plane is roaring through spaces which leave room for little more than a red cat's-whisker on either side. But this drill pays important dividends in tight spots. And it gives Mosquito pilots a superb sureness and skill.

The Mosquito can do wonders in proper hands. A short time ago a Wooden Wonder flown by Squadron-Leader J. R. G. Ralston who was accompanied by Flight-Lieutenant S. Clayton, spotted a German freight train entering a fairly long section of railroad tunnel. Men who fly planes of such phenomenal speed learn to think fast too.

First they dropped two bombs at the exit end of the tunnel and completely blocked it up. Then, winging over smartly, they rocketed back over the hump of the hill and bombed the entrance. Thus, a valuable trainload of war material was bottled up for more than a week.

They said the Mosquito would be just another crate. Maybe she is—for boxing up what's left of the *Luftwaffe*.

Oyster shells are made of aluminum, calcium, copper, iron, magnesium, manganese, silica, zinc, water, chlorine, carbon dioxide, and nitrogen, with traces of other ingredients.

Gas Ration Special

[*Continued from page* 93]

bolts. The rear axle is simply a 7" length of $\frac{3}{8}$" diameter rod threaded at both ends and fitting snugly through the center of the bearing on each end of the hub. Spacers between the outside of the bearing and the frame sides position the wheel securely.

The sprocket on the rear wheel is an 18 tooth unit of the disc type, held in place on the wheel by three 3/16" bolts and pipe spacers. The sprocket is held out from the wheel far enough so that it clears the tire by about $\frac{3}{8}$", and must be adjusted to rotate absolutely true, with no radial or side wobble. The long bolts are inserted in place of three of the short ones that hold the wheel parts together. Although the sprocket shown is a special unit, most bicycle dealers can supply one with the proper number of teeth, and which can be drilled for the three bolts.

The chain is standard bicycle variety of 1" pitch and 3/16" width, and the two sprockets must, of course, be of similar description. The chain is about 30" in length. While on the subject, it might be said that while the chain mentioned has proved quite satisfactory and will give good service if cleaned and oiled occasionally, a much better drive may be had from the so-called No. 41 N chain. This is $\frac{1}{2}$" pitch and 3/16" wide and is used on many racing bicycles as it is more suited to high speed work. The sprockets must be of the same type.

It is quite possible to use V-belt drive from the counter-shaft to the rear wheel. If this is done the wheel pulley should be about $5\frac{1}{2}$" diameter with a 3" countershaft pulley, the idea being to get a 2-1 ratio between the two.

The countershaft sprocket is a 9-tooth size, also a standard bike part, with an added steel hub. The shaft is $\frac{5}{8}$" diameter and is carried in a self-aligning ball bearing pillow block at each end. Ordinary bronze-bushed bearings are quite usable, but must be oiled more often. The sprocket hub should be pinned to the countershaft with a taper pin or plain $\frac{1}{8}$" diameter rod. Set-screws simply will not hold here for any length of time unless used with a keyway of some sort. After trying vainly to make the sprocket stay put, it was finally pinned, keyed and held by two set screws, and has not budged since being so fastened.

The countershaft is cut flush with the bearing on the right end but projects $2\frac{1}{4}$" beyond the left bearing. On this end are fastened two $5\frac{1}{2}$" diameter pulleys.

The motor pulley is the type with $1\frac{3}{4}$", $2\frac{1}{4}$", $2\frac{3}{4}$", and $3\frac{1}{4}$" steps, only the first and third of which are utilized. The "gear shift" is very simple but highly satisfactory. The two V-belts are left in place at all times but are too loose to provide any power transfer from motor to countershaft. When the shift lever is pushed downward, a pulley is lowered onto the top of the inner belt, tightening it so that the countershaft is driven. For high "gear" the lever is then raised upwards past the center position where both belts are loose, until another idler pulley is forced up against the underside of the other belt, which tightens it and again drives the counter shaft, but at a higher speed.

The two idler pulleys are of ball bearing construction, and each is held to the shift rod by a single $\frac{1}{4}$" diameter bolt. Roller skate wheels are good for this use; if flanged pulleys are obtained they must have a width inside the flanges of at least $\frac{1}{2}$". Plain bearing types are not advisable here as the pulleys turn at high speed and are under considerable load.

Some means must be provided to hold the shift arrangement in the desired position, whether up or down. An auto brake lever ratchet and pawl have been adapted for this use, and while the make is unknown, the builder can probably find something satisfactory at his local supply store or "junkie."

Most of these ratchets are designed to hold in only one direction and slip the other way, so the teeth must be filed to such a shape that they will hold in either direction. The pieces are usually case-hardened but can be softened for drilling and filing by bringing them to a red heat for a few minutes, then allowing them to cool slowly.

The ratchet piece was drilled large enough to fit over the bearing of the shift lever and is braced by a piece of 1"x3/16" steel running down to the frame. The bearing is a piece of brass tubing $\frac{5}{8}$" in diameter with 1/32" wall thickness, inside which is the shaft itself, a length of $\frac{1}{2}$" diameter rod, turned down to $\frac{3}{8}$" at each end and threaded. The tubing is brazed to the angle iron seat braces.

The shift lever is bolted onto its shaft with the pawl on the overhanging rear and actuated by a 3/16" rod run forward through the wooden handle. A spring keeps the pawl tightly against the ratchet except when the push rod button is depressed.

The shift rod which carries the two idlers is held to the lever by a single $\frac{1}{4}$" diameter bolt and another bolt of the same size keeps the lower end of the rod in place. The slot is $3\frac{1}{2}$" long which allows the rod a vertical movement of about the same distance. Both of the bolts are provided with bronze bushings to reduce wear. The rod must be held out about $\frac{7}{8}$" from the frame so that one idler can be placed on each side. The holes for the idler pulley bolts should not be drilled until the motor and countershaft are mounted and the pulley and belts put temporarily in place to be sure the idlers will be in the proper location.

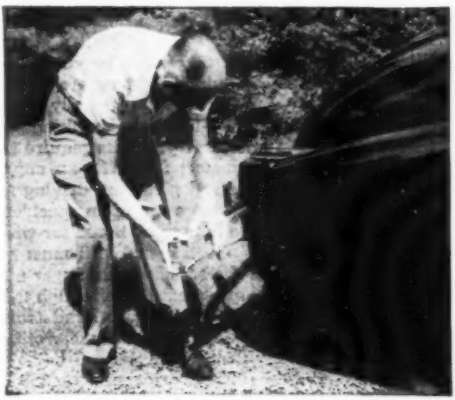
A spring coupling is provided between the lever and rod as may be seen in the illustration. The rod is bent out at right angles at the top and an

[*Continued on page* 142]

Your Wartime Car

by Frederick C. Russell

If you have a problem with your car, ask Mr. Russell. Just send a stamped, self-addressed envelope for a personal reply.



If the oil gauge line is squeezed so that it shuts off oil to the gauge will the engine continue to be lubricated? B. N. F.

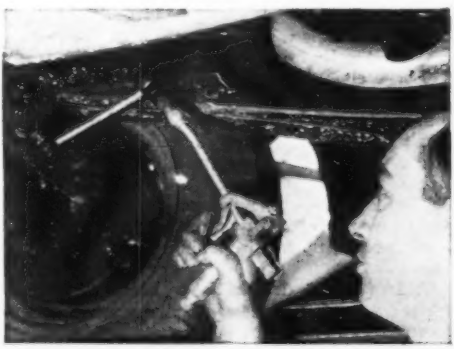
Yes. The accompanying cutaway of the typical oiling system will show you why.

What would cause rattling in the clutch? J. B., Jr.

Weak retractor springs will do this.

The motor heat indicator on my car remains on the danger side even when the engine is cold. G. S. N.

There may be a break in the unit's coil wire.



I am rebuilding the engine and would like to know within what limits to hold main bearing end play. C. C. B.

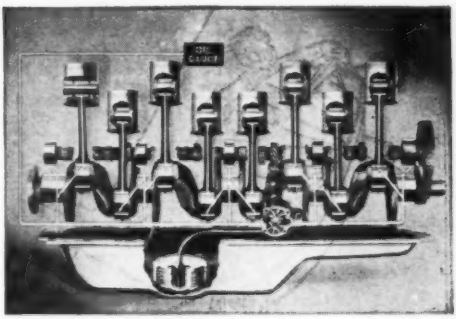
On your job this can run from .004 to .007 inch.

Try it!

Breaker points often must be replaced because the fibre block is worn down from riding a rough spot on the cam. To be on the safe side run your finger over the distributor cam and smooth off any rough spot that shows up.

Before pounding out a dent in the right rear fender I will have to remove a bad buckle. How is this done? M. S. C.

Brace a strong board against the rear bumper and use this as a lever to press out the buckle.

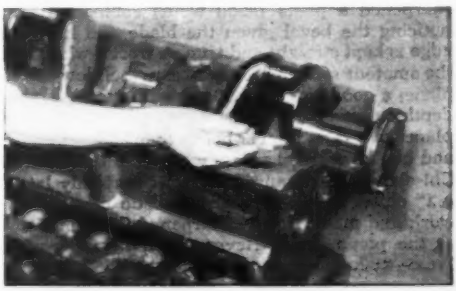


Gas mileage has been low lately. Shouldn't it be higher in warm weather? F. R. N.

Stop parking the car in the hot sun as heat causes excessive evaporation of gas.

There is resistance in the steering of my car. Everything has been well lubricated. L. McK.

Everything? How about the axis of steering lever on this job?

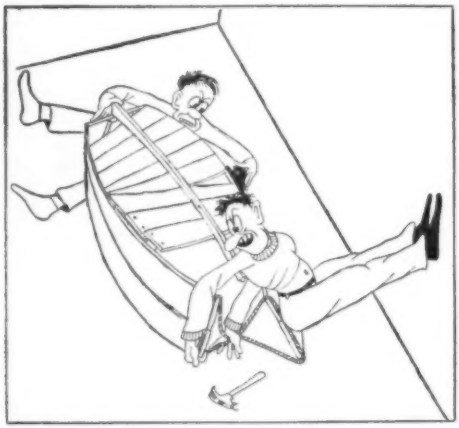


Tools For Boat Building

[*Continued from page* 111]

mounted plumb and square to the form or baseline.

With a larger boat built rightside up, the backbone assembly will be set up first, then molds mounted atop it. Here, much of the hardest part of the building—getting out these usually heavy members—can be avoided by drawing the shape of each accurately on actual stock, then taking the whole business to a mill bandsaw for cutting out. This may even be necessary when one has a small power bandsaw but finds these main members too heavy for it. Saw to the outside of all lines, then dress the pieces down on the job while assembling. A 22" jointing plane should really be used for trimming long edges perfectly straight, but by working carefully with the eye and a straightedge a shorter 9" smoothing plane will suffice. Its cutter or blade must be kept very sharp,



Rope can be used as a tool for drawing in the springy side planks of a skiff under construction, but NOT in the manner demonstrated by the amateurs above. The little man with the bare midriff may be shot right through the wall at any moment.

not on an emery wheel, but ground on a grindstone then whetted on an oilstone. If you've never sharpened a plane blade watch someone do it, noticing the bevel given the blade and how the edge is kept straight and true. A worth-while tool the amateur seldom uses is a very small low-angle plane; a good tool of this type with an adjustable depth cut can be used one-handed, will get power planer marks off lumber better than a larger plane, and can be worked places where the latter can't. Chisels will be required now and certainly later; a 1" chisel and a ½" chisel will do most of the work and must be kept sharpened the same way as the plane blade. Never use a hammer with these—make yourself a hardwood mallet. A brace and bits will be necessary to bore for fastenings; the former a ratchet type but not necessarily an expensive one. Lead holes for small fastenings can be bored with drills in your automatic screwdriver, while a set of bits for the brace—sizes from ¼" to ¾" (preferably in 1/16ths) will suffice for other boring. For deep holes for drifts and long bolts 17" ship augers, without a screw, will bore true, although they must be started in a hole bored with a regular bit. They are rather expensive to buy, but the designer usually standardizes on sizes of heavy-fastenings, making but one or two such bits necessary. Bolts require an auger of the same diameter; for drifts an auger 1/16th smaller than the rod gives the driving fit required. Quarter-inch bolts are often specified, and where these are too long to be bored for with an ordinary bit an 18" electricians' drill must be used because 5/16" is the smallest size auger bit.

This brings to mind electric drills, although this article is meant to deal chiefly with hand tools. The ½" heavy duty type is too expensive for other than professional builders but if one can be borrowed for a weekend or a few evenings a lot of otherwise hard boring on a sizeable boat can be quickly done. A low-priced ¼" drill will, however, easily save its cost in speeding up building time of any boat 24 ft. or under.

An ordinary hatchet if kept very sharp will be found handy for roughing out members of the backbone. Having work on heavy timbers done at the mill, as mentioned, will make an adze unnecessary, but where this is impossible it will be worth while to master the use of this tool. Buy a lipped type, keep it perfectly sharp, and cut across the grain rather than with it. With the exception perhaps of a machinist's or ball peen hammer to use for heading up and rivetting ends of drifts, a punch for setting their heads, and a hacksaw for cutting such rods to length, the aforementioned tools will get you through this heavier part of the building.

Large clamps would have been very handy to hold such heavy members together for fastening but are too expensive for such special use: if they can't be borrowed, your ingenuity with braces, props, and wedges will usually suffice. Half a dozen small clamps, however, will be a great help in planking, and elsewhere about the construction; low-priced quilt-frame type for very light construction, up to 6" opening C style for larger boats.

A 10" or 12" drawknife will come in handy for roughing out edges of planks requiring shaping, saving much planing where a bandsaw isn't available. If plugs are to be used over fastenings a patent counterbore that countersinks for the head and plug as well as bores for the lead hole will be worth its $3 cost. If calking is required a common type iron 1/32" thick will suffice and one can use his hardwood chisel mallet, rather than

[*Continued on page* 144]

Helping Build the Army's Bridges
"Bridges quickly built where wanted" . . . might well be a slogan of the Army's resourceful Corps of Engineers. When a river blocks the movement of thousands of troops, minutes are priceless . . . and the Engineers waste none of them!
Swiftly the Engineers' bridge equipment speeds to the chosen crossing. Big, buoyant pontoons are launched, maneuvered, and secured in position. Bridge decking is extended over them . . . and like magic a floating roadway stretches to the farther shore, ready for the tramp of troops, the rumble of tanks and trains of supply trucks.
Helping build the Army's bridges is one of many war-time jobs where Evinrudes serve with unflagging power and rugged stamina. Delivering to our fighting forces the finest outboard motors that skill and long experience can build . . . that is Evinrude's responsibility today. And you can be sure that, after Victory, the Evinrude you can't buy *now* will be a motor *worth waiting for!*
EVINRUDE MOTORS, *Milwaukee, Wis.*
Evinrude Motors of Canada, Peterboro, Canada
EVINRUDE
OUTBOARD MOTORS

★ EVERY DOLLAR HELPS SPEED VICTORY . . . BUY MORE BONDS!

Crop By Vignetting

[*Continued from page* 86]

with a little powdered pumice. The pumice is also handy for removing too much powder.

Pumice is applied lightly with a wad of cotton charged with the powder. Blending may be done on a piece of scrap paper before-hand.

For a head and shoulder portrait the powder is applied lightly all around the head and blended out into the background until it does not show near the edges. Then several swipes are made across the background with a piece of art gum to give it an artistic finish. This hand sketching in the background follows no definite pattern; its variations are guided only by the individuality of the workman. It must be remembered, however, that too many different marks cause confusion and serve to defeat the whole idea behind making the vignette in the first place.

When drapes or clothing are printed too light, they may be retouched with this powder—applied with a small pad of cotton or a swab of cotton wrapped around the end of a small stick. Edges and highlights may be picked out then with the art gum.

When you are making a negative to be vignetted, much of the work and headaches of printing can be avoided by a little forethought in making your exposures. The background can be any of several soft, white, non-glare materials and should be separately illuminated by a light behind the subject, or a spotlight focused on the background from the side and behind the subject. Care must be taken that this light is not out of balance with the front lights. A light too strong in proportion to the amount of frontal lighting will glare in the lens and cause excessive flatness in the portrait.

While on the subject of lighting for vignettes, it shouldn't be overlooked that vignettes are no place for too much backlighting. For instance a line light from the rear in a profile view will cause loss of all separation of background from subject and perhaps entirely spoil the portrait.

The subject should be far enough away from the background so that a shadow of the subject will not accidentally be cast on the background, for it will be difficult to vignette out. If it is desired to use a cast shadow on the background as a part of your composition with no intention of vignetting out that part of the work, it is quite another matter.

This interesting printing method is worth trying if you have not used it before. If you are careful and follow the simple rules, chances are you will have something well worth your time. Try it on some of those negatives about which you have been undecided; maybe on one of those that has the head far off center; or the one of the baby in which the hands were a complete blur.

Negative Integrator

[*Continued from page* 87]

mount, until it is concentrated through the aperture in a small beam. For best results the bulb should be about 1" below the opening. When carefully focused, the meter should give a clear reading of about two hundred candles per square foot.

A hinged panel is screwed to the lid of the box and another ½" hole in drilled in it directly above the light hole in the lid. The exposure meter is mounted on the panel by retaining strips along the sides and an elastic band is snapped around both the panel and meter. The center of the photo-electric cell opening should rest over the hole drilled in the panel.

To use the densitometer, a clear reading is taken and a table of opacity and density values is made:

$$\text{Opacity} = \frac{\text{Clear reading}}{\text{Light transmitted by negative}}$$

Density = Logarithm of opacity.

Meter Reading	Opacity	Density
200	1.0	0.0
160	1.2	.08
130	1.5	.18
:	:	:
.8	25.0	1.40
.1	200.0	2.30

In the case of Weston meters it is only necessary to count the number of blocks reduction in reading in order to find the density of the negative in tenths.

The greatest use for an integrator of this type is to find accurately the contrast of a negative. A second use, in which a table of densities must be used like that above, is to check exposure. Suppose the straight-line portion of the characteristic curve of some imaginary film, for a given time of development, begins at .3 density units and ends at about 1 2. Making two readings from the shadow and highlight portions of the negatives in question, it is simple to determine whether these densities lie within these limits, and hence whether the film is correctly exposed.—*Brian A. Loveridge.*

German troops sing as breathing exercise as well as for morale, says an American who soldiered in Germany, and he adds that some Army songs are written to require deep inhaling and exhaling.

Many children of pioneers in the Australian bush get their education by correspondence.

Laying hens particularly need cool water, shade, and ventilation as heat stroke prevention aid in hot weather.

PRECISION IN ACTION

BIG GUNS DON'T FOOL!

WHEN you're out to smash a tank concentration ten miles away, you don't hope to hit your target by merely pointing.

You make sure, by means of precision instruments, without which no long-distance weapons can be fully effective.

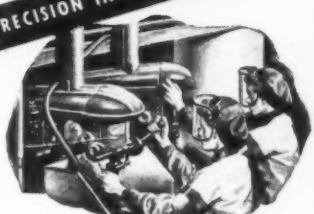
And by far the most widely used of all precision instruments in all operations, are binoculars.

Universal alone now makes more binoculars for the Army, Navy and Marines, and the United Nations, than the entire industry made before the war.

This is quantity production hitherto thought impossible in instruments of such high precision—much of it *made* possible by Universal engineering research. Today, outstanding accuracy in lens-making is achieved more easily and economically than ever before, *anywhere in the world.*

Hence, Universal looks forward to a new impetus in the development of photographic and optical instruments—invites *you* to look forward to finer-than-ever cameras, available to everyone.

PRECISION IN THE MAKING



A Soldier with strained eyes is a wounded man Metal parts are finished for perfect alignment on special machinery designed by Universal. Practically *no* tolerance is permitted, for if each eye is forced to focus independently, there is strain, as incapacitating to a soldier as a bullet wound. Today's advances in precision promise finer optical and photographic equipment tomorrow.

There's only one flag we're prouder of!

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Makers of Precision Photographic and Optical Instruments • Peacetime Manufacturers of Cinémaster, Mercury, Corsair Cameras

[*Continued from page* 105]

a glass globe of the earth set inside a cylinder, and that in the center of our globe we have a very small but powerful electric light bulb. Shadows of the various points on the surface of the globe will be cast on the inside of the cylinder. If our cylinder is made of photographic paper, we can record these various shadows. Then we can cut the cylinder through one side with a pair of scissors as in Fig. 5, spread it out flat and we will have the map shown in Fig 4. Notice that the meridians are parallel to each other, that the parallels also are parallel to each other, and that the meridians and parallels intersect at right angles. Notice also that the parallels are farther apart as they approach the poles. On the globe of the earth, however, the meridians converge at the poles and the parallels are the same distance apart. Our Mercator projection, then, has the disadvantage of having a great deal of distortion near the poles and therefore no constant distance scale. We can't say that 1 inch equals 1,000 miles, for example. This distortion can be seen in the drawings at the top of page 104.

The Lambert conformal conic projection (to give it its full name) uses the surface of the earth projected on a section of the surface of a cone. To visualize this we can use the same glass globe and photographic paper device we used for the Mercator. When we have our print on the inside surface of the cone, we can cut it from top to bottom as in Fig. 7, spread it out and have a map similar to that in Fig. 6. For the United States the strip of the cone corresponding to the section of the earth from the 25th to the 49th parallel is used. In it the meridians converge slightly toward the North Pole and the parallels curve upward. Notice that the curved surface of the cone coincides almost exactly with the curved section of the earth at these latitudes. Therein lies the value of the conic projection. It is almost, but not quite, a true reproduction of the globe for this section, and is the type used in air navigation. The Mercator belongs to the era of slow-moving sailing vessels, but still finds use in marine navigation over large portions of the seas and oceans. The *gnomonic* projection shown in Fig. 8 on page 104 is the surface of the globe projected on a flat surface or plane by rays from the center. Its value lies in the fact that from its center point distances may be measured off exactly to scale. Another type of chart, the *azimuthal*, is gaining in popularity due to its adaptation to the long distance flights necessitated by the present war. It is not as accurate as the Lambert but can include a much wider area.

Probably you have often wondered why it is that ships sailing from New York to London take a route which leads them up past the shore of Newfoundland, through the Arctic Ocean and then down to England. At least that is the course shown in Mercator charts in most geography books. To answer this question we must refer to our discussion of the great circle track once more. If you will look at Fig. 9 and the accompanying photo, you will see that the route described is the shortest distance between these two points because it lies on the great circle track. Stretching a string from New York to London on the globe will show this. In Fig. 10 if we desire to fly from New York (A) due east to Lisbon, Portugal (B), we will arrive there surely by maintaining an easterly course. How much shorter our trip would be, however, if we hopped over the top as shown! This shorter distance is our great circle track.

"We flew too low over Arkansas!"

Now let us consider the Mercator, Lambert and gnomonic charts with reference to our problem of navigation. Let us say that we desire to fly from A to B, two cities in the United States about 300 miles apart. On the Mercator chart, a straight line drawn between these two cities will indicate the direction of A to B but *not* the *shortest route* we can take. On the gnomonic chart a straight line from A to B will not give us the direction of A to B but only the great circle track or shortest distance between them. On the Lambert chart, however, the straight line will tell us approximately *both* the great circle track *and* the direction between the two cities. The slight error over a 400 mile course is shown in Fig. 11. The line of constant direction (the dotted line) such as the straight line on the Mercator chart, is called a *rhumb* line. A rhumb line is one which makes the same angle with each meridian.

To find our course on a Lambert map, this is the procedure. First we draw a straight line on

[*Continued on page* 140]

In ten more minutes what will you be doing?

IN TEN MORE MINUTES they'll be in action—risking life and limb to conquer one more bridgehead on the road to freedom.

And in ten more minutes—what will *you* be doing to help win this war?

Because it's up to you as much as it's up to them. Unless you—and all the rest of us at home—are devoting every spare minute of our time to fighting this war as civilians, *their* chances of victory are slim.

Next time you read of an American raid on enemy positions—with its tragic footnote of lost planes and ships and men—ask yourself:

"What *more* can I do today for freedom? What *more* can I do that will save the lives of men like this and help them win the war?"

* * *

To help you find *your* place in America's War for Freedom, the Government has organized the Citizens Service Corps as part of local Defense Councils. Probably there is one of these Corps operating now in your community. Give it your full cooperation. If none exists, help organize one.

Write to this magazine for a free booklet, "You and the War," telling you what to do and how to do it. Choose what you will do now!

EVERY CIVILIAN A FIGHTER

Contributed by the Magazine Publishers of America

The School Shop

[*Continued from page* 138]

our Lambert chart between our point of departure A and our destination B. The course which we must follow to fly from A to B will be the angle between our direction AB and the meridian nearest the halfway point in our trip (angle "a" in Fig. 12, page 105). The course is measured by means of a protractor in a clockwise direction from this meridian or North line. In Fig. 12 it is aproximately 60°. The course from B to A (returning home) is called the *reciprocal* course and is indicated by the angle "b." The difference between angles "a" and "b" is 180°. Angle "b" will be 240°.

We have said that a course angle is measured at the meridian nearest the halfway mark of our trip. The angle between our trip and *any* meridian along that trip is called the *bearing* at that meridan. For example: Angle "z" is the bearing at A; angle "z'" is the bearing at B for the trip from B to A.

Before we go any further in our study, we will have to spend a little while with the instruments necessary for good navigation. These will be considered in the next lesson in September MECHANIX ILLUSTRATED: *Lesson 8—Instruments for Navigation.* In the meanwhile study this lesson carefully and when you think you have mastered it, test yourself with the questions on page 144.

This series of lessons is for the benefit of aviation instructors, cadets, preflight students and others interested in aviation. When complete, it will furnish a complete text on the subject. Save all the material for study and future reference.

What do you think of these lessons? We will welcome any criticisms or comments you may have in regard to them. Address your mail to: Aviation Editor, MECHANIX ILLUSTRATED, 1501 Broadway, New York 18, N. Y.

Handy Holders For Yarn

[*Continued from page* 130]

a handy dispenser. It may also be used to hold thread while crocheting. A slot in the head holds the end of the string when not in use. Jigsaw the head from 1" stock and drill a ½" hole 1" up into the bottom. Cut a 5" disk from 1½" wood, drill a ½" hole 1" deep and glue in a 5½" length of ½" dowel. Paint the cat's face yellow, eyes green, outlines black. Set the twine over the dowel; then put the head on.—*R. L. Fairall.*

The standard gauge of our railroads—four feet, eight and one-half inches—goes back to the clearance width established for Roman chariots.

Food Dehydrator

[*Continued from page* 95]

plywood measuring 17"x33" with a ⅜" rabbet 2 plies deep around the inside to fit the front frame of the dehydrator. A pair of hinges, a handle and a catch complete the assembly.

Five 14½" strips of ½"x1" pine are tacked to the sides of the box at 3½" intervals to support the trays. The lower strips should be about 16½" from the bottom so that the lower tray will be well above the fan and bulbs. The five trays are made of ½"x1" pine strips and are 15½" wide and 17" long, each tray consisting of two side strips 17" long and two end strips 14½" long. Cover the bottoms with a mesh wire fine enough to prevent the dehydrated particles from falling through the holes.

Screw a pine block to each side about 4" below the lower tray and mount two bulb sockets on each block. Four 100-watt bulbs will supply heat for your dehydrator. Wire the sockets in parallel as shown in the photograph. An electric fan tilted to a horizontal position and placed beneath the bulbs will complete the job and you will be able to commence dehydrating. If your fan is one which can't be placed horizontally, you can take the motor assembly from its stand and rig up a support for it.

Vegetables to be dehydrated should be first cleaned and then shredded or sliced. When they are placed in the trays and the bulbs and fan are turned on, the fan will blow the warm air from the bulbs up and through the vegetables and out the ventilating hole in the top of the dehydrator. Start your machine when you go to bed at night, and in the morning the crisp, curled slivers in the trays will be your dehydrated potatoes, beans, and what-have-you. They may be stored till future use in waxed-paper bags which you can "knock out" in a few minutes with the aid of a stapling machine.—*G. Paust.*

Cabinet Lathe Stand

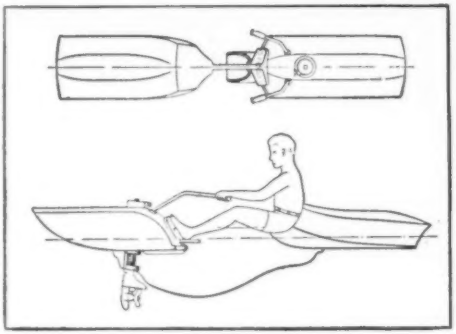
[*Continued from page* 121]

back. By unscrewing twelve screws it can be moved.

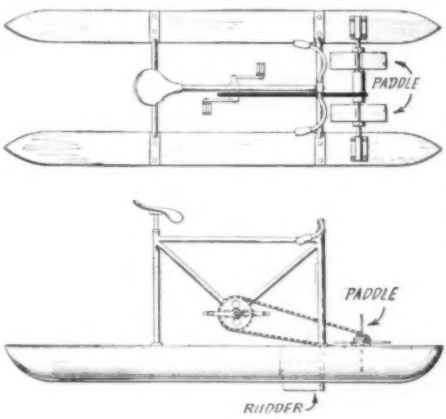
After the lathe was set up on the cabinet stand, a discarded, extension light bracket was discovered. This promised to be ideal for holding a light bulb over the work and so a 2x4 was bolted in an upright position at the tail end of the cabinet and the bracket screwed to it. An old automobile head light coated with aluminum paint was placed on the socket and a 100-watt lamp used. Connected by an extension to the cellar light, this serves as a satisfactory source of illumination. The light can be moved forward or backward and placed just where it will give the best lighting.

The only commercial tea plantations outside the Orient are in Guatemala.

Popular Patents



A new type of aquatic motorcycle has been invented by Theodore Drake of Avalon, Calif. The vehicle has front and rear floats spaced so as to provide a cockpit or rider's seat. An interconnecting ridge element joins the floats and also assists in steering action through tilting, familiar to all bicycle and motorcycle riders. The forward float is provided with a conventional outboard motor having a submerged propeller for driving purposes. By means of handle-bars, the front float can be pivoted about a central shaft to accomplish very sharp turning. (No. 2,286,350.)



And here is a real bicycle water-buggy. Elwood Perry of Charlottesville, Va., simply took two floats and connected them by a bicycle-type frame. The pedal-driven sprocket wheel drives through a usual chain two small paddle wheels mounted in the front to propel the craft through the water. Reverse motion is obtained merely by pedaling backward. A rudder and handle bars assist in maneuvering the vehicle. (No. 2,287,706.)

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MOTORCYCLES

Gas Ration Special

[*Continued from page 132*]

extension made from a ⅜" diameter bicycle rear wheel shaft bolted on. This slides through two holes in a U-shaped metal piece, with a spring at top and bottom. A bolt over the upper end keeps the whole assembly in place and is turned tight enough to place the springs under considerable pressure. Such a device prevents overstretching the belts and makes the drive smoother.

This completes the heavy construction work, but many other details remain. The floor boards are of 9/16" plywood held on with bolts. On one side a cut-down bike kick-stand is fastened, bolted both to the floor and the frame for strength.

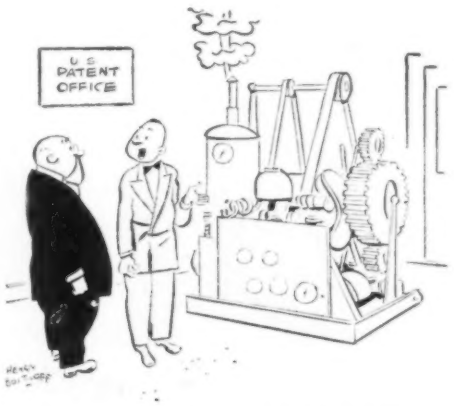
The motor is fitted with a simple muffler and a long tail pipe and is surprisingly quiet in operation. Construction details are shown on the drawings. The muffler body tubing and the exhaust pipe ends are closed with discs of 1/16" steel sheet brazed in place. The small tubing has about 20¼" diameter holes in each piece which appear to be ample.

A guard piece of ¾"x⅛" strap iron, bent upward at the front and bolted to the floor board, runs rearward about on the centerline of the frame. The rear end is supported by the angle piece which guides the after end of the brake cable. This guard projects about 1" lower than the muffler and protects the brake mechanism, and the countershaft pulleys as well, when the machine is being lifted over curbs and other obstacles.

The sheet metal gas tank is fastened to the seat support in front and the rear is held up on a frame of ¾"x⅛" strap iron. This frame is extended over the tank to form a handle that is very convenient when lifting the vehicle.

Front and rear fenders are bent from No. 20 gauge sheet steel; the one in front is braced by strips of 16 gauge sheet riveted in place. Both fenders are the flat crownless type,—all that can be made without extensive sheet metal working equipment.

The brake is external contracting and works on an ordinary 3½" V-pulley keyed to the countershaft. The brake band, cut from 20 gauge steel, has a lining of heavy leather. A simple toggle arrangement tightens the band around the V-belt and is actuated by a foot pedal on the floor board. The two are connected by a piece of auto choke wire.



"It has no practical value, but it works!"

The carburetor controls of choke and throttle are on the handlebars, operated by bicycle-type flexible wire cables.

Some States (such as New Jersey) require two headlights and a tail light before a license will be granted. The lights used here are all bicycle products operated by a small bike generator driven by the rear tire. As this does not produce quite high enough voltage, the generator is now being belt driven from the countershaft.

A great deal of experimentation has been done to ascertain the proper drive ratios. Although the photos show different size pulleys on the countershaft (they were 5" diameter for "high" and 6½" for "low") these have been replaced by two of 5½"diameter, which seems about right for the motor used. The ratio from motor to rear wheel (using pitch diameters of the pulleys which average ¼" less than outside diameter) and including the 2 to 1 afforded by the chain drive is thus about 4.2 to 1 for high and 7 to 1 for low. This provides a top speed of about 25 m.p.h. in high and makes for easy starting and plenty of power for hill climbing in low. Using the pulleys shown in the photos, the ratios were 3.8 to 1 and 8.3 to 1 respectively, but these were thought to be a bit too far each way for best results. All the belts and pulleys are ordinary ½" wide home workshop equipment.

A simple device was developed to prevent the V-belts from pulling when the shift is in neutral, a natural tendency even though they are quite loose. An angle bracket is mounted on the motor crankcase, the end projecting outwards just in front of and below the motor pulley. To this are bolted two strips of brass ⅛"x⅜"x2" long, bent so they just clear each belt when it is tightened to the running position. They prevent the belts from wrapping around the pulley when loose.

Persons under 19 years of age comprise 45% of the Soviet Union's population, compared with 32% in Great Britain, 30% in France.

Because eating spoiled food may cause animals to become ill, home economists advise burying any spoiled canned food with a tablespoonful of lye to each quart.

Will The Earth Sock Japan?

[*Continued from page* 44]

machines make continuous records twenty-four hours a day.

The essential parts of a recorder are a light source, a galvanometer, a revolving drum, and lenses to focus the light reflected from the galvanometer onto a light-sensitive photographic paper attached to the drum. As an increase of electric current comes from a seismometer, it actuates the coil of the galvanometer to which a small mirror is attached. This impulse causes the mirror to turn slightly, thus deflecting the light beam—actually a mere pinpoint—that is focused on the paper.

When the seismogram—the developed paper strip—is studied, the wavy lines caused by the displacement of the light beam, being proportional to the amount of earth motion, show the time, amplitude, duration, and other characteristics of the most minute earth tremor.

Some interesting problems present themselves when it becomes necessary, as it does in the study of earthquakes, to have an accurate means of determining the exact time of any point on the seismogram.

To accomplish this, three factors must be considered. First, the rotating drum, on which the photographic paper is attached, must revolve at a constant speed. Otherwise any accurate measurement of the record would be impossible. Second, a way must be provided for the recording of exactly spaced time intervals. And, third, this time marking must be correlated with some outside source of accurate time obtainable at several different points at once. This last is most important when records from other stations of the same quake are studied.

At the Pasadena station the rotation of the recording drum is kept at a constant speed through the use of a tuning system—a tuning fork controlling the frequency of oscillation in a vacuum tube circuit, the output of which actuates synchronous motors that drive the recording drums at the exact speed of one millimeter per second. As a result, linear measurement of 60 millimeters on the seismogram is equivalent to one minute of elapsed time.

To accomplish the second need, the recording of time intervals, a special device known as a minute marker is made an intregal part of the optical system of each recorder. Every minute, an impulse of electric current comes from the station's masterclock, and causes a slight movement in the device. When this happens, the recording light beam is deviated from its normal line for a moment, and a clear off-set on the record is made from which future measurements are possible.

To get the outside time reference, a radio receiving set controlled by a time-switch is permanently tuned for reception of navy time signals,

[*Continued on page* 145]

VITAL as guns, tanks, planes, ships, tractors, trucks, and all the other implements of modern warfare, are the tools which help to build them.

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Tools For Boat Building

[*Continued from page* 134]

buy an expensive calking mallet. The putty knife required to fill seams you'll likely already have.

With the hull completed and the boat ready for decking, trim and possibly a cabin, a low-priced spoke shave will be found useful for shaping curved members; a rasp and a coarse wood file for similar work or enlarging cuts made with the keyhole saw; and a small cheap nail set or punch. The few wrenches required during the construction will likely be found among your car tools, while a 10" pipe wrench needed for installing an engine or toilet can be later carried as regular equipment.

A rabbet plane is rather an expensive tool for the few times it will be required, and grooves for drawer bottoms, panel inserts and other places in the cabin joiner work can best be cut at your local mill.

The tools mentioned as essentials here do not make too formidable a list, but will provide a well-stocked chest for average building. Clean, sharpen and oil them when you've completed the boat and store them where they're not apt to rust. With experience gained you can add other tools from time to time that you think will make for quicker, easier or better building. For once the boat building bug has bitten you chances are you'll be needing them again sometime.

Picnic Novelties

[*Continued from page* 99]

and the hands nailed in place. Paint the body of the holder white; shellac the faces and hands; paint the noses red, the ties black, and the sombreros orange and yellow. Fasten to a wall or fence with screws.

Individual trays of Masonite, fiberboard or ¼" plywood and made to fit conveniently on one arm are designed to hold a plate and glass securely. The heart-shaped tray and scalloped edge sections are traced to any ¼" stock, jigsawed out, and then the scalloped section is glued to the tray. The feet, 2"x8" curved to fit over the arm, are cut from 1" stock and nailed to the underside of the tray. The handle, a 1"x1" section 2" long and rounded at the edges, is attached to the underside near the point of the heart. These trays may be finished in white and the edges trimmed with red or finished the natural color of the wood.

Since a newly hatched clothes moth larva can crawl through an opening 4/1,000 of an inch wide, government antomologists advise sealing cracks in clothes chests with gummed tape.

More than three-fourths of the major oil fields in this country have been discovered by scientific techniques.

QUESTION BOX

These are the questions on Aviation Lesson 7—Maps of the Earth, which starts on page 100 in The School Shop. If you can answer them without much trouble, you've gotten a good start in your study of Navigation. Be sure you have mastered Lesson 7 before diving into Lesson 8—Instruments for Navigation, in September MI. Answers to these questions are in the text.

1—Define *navigation*. What is the shape of the earth?
2—What causes the seasons? Day and night?
3—The earth rotates at the rate of how many degrees per hour?
4—How many nautical miles are there in one degree of longitude at the Equator?
5—How is the nautical mile determined?
6—Define *latitude* and *longitude*. Define *Greenwich Meridian*.
7—What is a *great circle*? The *great circle track*?
8—Describe the features of the *Mercator projection*. The *Lambert projection*.
9—What is a *rhumb line*? A *reciprocal course*?
10—Describe how you would determine on a Lambert map the course between two points about 300 miles apart.

Four Watt P. A. Amplifier

[*Continued from page* 127]

circuit is controlled by a switch on the phonograph input volume control.

Of course all soldering is done with rosin core solder and a clean bright iron. Be sure the solder flows evenly on each connection before taking the iron away. It is interesting to note that a high percentage of trouble with new equipment is due to poor soldering.

When you have gone as far as possible with the wiring, mount the rest of the parts and complete the connections.

Now recheck the wiring thoroughly before connecting to the power line. It is particularly important to observe the polarity of the electrolytic filter condensers, since if the connections are reversed on these a short will result with damage to the condenser and possibly also to other parts in the circuit.

The amplifier is now complete and ready to go. You will find it a highly efficient and flexible instrument as it lends itself readily to all portable equipment where amplifiers are used.

In the War Department's map collection there are more than a million maps, atlases, guide books and other items.

British aviators on night fighter patrols are required to eat carrots for vitamin A, lack of this vitamin being a cause of night blindness.

Helpful to home gardeners is the advice of government scientists that starting seeds on a layer of sphagnum moss prevents "damping off" of seedlings.

Will The Earth Sock Japan?

[Continued from page 142]

broadcast six times a day. A relay system automatically sends these radio impulses to the recorders where they become a part of the seismogram.

After a quake has occurred, seismologists determine the arrival times of the two earthquake waves from the record, making the necessary corrections for the difference between station time markings and radio time.

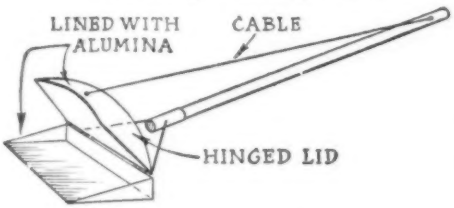
For a near-by earthquake the approximate distance from several stations where it is recorded is determined from the difference in the arrival times of the two waves at each station. These distances used as radii for arcs of circles are laid off on a small-scale map, and the point where the arcs intersect is taken as an approximation to the epicenter. Records from three or more stations are needed for this calculation, for a pair of intersecting circles have two points in common, and without the third arc, it could not be determined which of the two intersections was the proper one.

On distant shocks a much more intensive and thorough study is required of the records to estimate the distance to the epicenter. And always it is necessary to have records from stations which are at considerable distance from one another to make an exact determination. The Pasadena station, for instance, is in reality part of a network of seven stations which work together as a team.

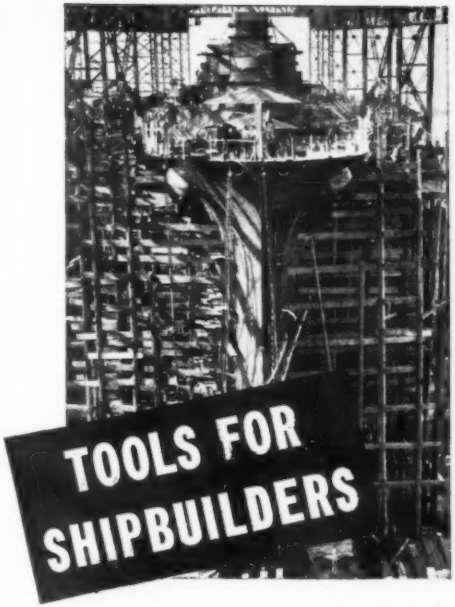
When one considers that thousands of earthquakes are recorded yearly, and that the photographic strips on the recorders are changed daily, some estimation may be gained of the endless amount of work and study involved in the science of seismology.

But who will deny its worth if, sometime in the not too distant future, the country's newspapers carry over a Pasadena dateline, the banner: TOKYO DESTROYED AGAIN BY EARTHQUAKE!

For Handling Incendiary Bombs



For handling the smaller, but still dangerous incendiary bombs, Everett Wilcox of Hyattsville, Md., offers a contrivance resembling a dustpan with a hinged lid, on which he has received patent 2,315,831. The bomb-remover and its arched cover are lined with alumina or other refractory material, and mounted on a safely long handle, with a cable for raising the lid.



The call to arms meant an equally urgent call to tools—for an immense building program sprang to life to take care of our mightily expanding fighting forces.

Throughout the shipyards, the plane factories, the arsenals and all wartime industry, workmen are busy with Disston files, hack saw blades, tool bits, and many other wood and metal cutting tools.

And in the hands of the craftsmen who are building the cantonments, the depots, the emergency housing of all kinds are Disston saws . . . preferred for their fine steel, excellent balance and fast-cutting blades.

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1863 Austin Steamer

[*Continued from page 115*]

dependable. As the speed probably was not over three or four miles an hour, however, the hazard was slight, even though the vehicle was not equipped with brakes.

In making the model—which we remind you is not to exact scale, but designed for easy construction by the novice—a solid wood body presents fewer complications than one built of thin material. For the dash board use heavy-gauge galvanized sheet, and the same material can be cut for the main leaves of springs, auxiliary leaves being of thin balsa or pasteboard. Small brackets for spring hangers are of wire with the ends flattened for drilling. Connecting rods, radius rods and the like are easily made of bicycle spokes or thin dowels, and the water glasses for boiler and tank should be bright wire to resemble glass tubes. Make the front axle of wood, and the yoke over it to which the spring is attached should be either heavy wire or rattan steamed and bent. The curved steam and exhaust pipes on the cylinders could be of sphagetti softened with moisture and dried in the shape illustrated.

Crank shafts are of wood, inserted in sleeves attached to the sills, as shown. A pinion from a broken clock will serve in the steering gear, or it can be whittled from wood, as is the rack. The bracket for these is also of wood. Wheels are made as described in the preceding model articles, or as shown here in the sectional drawing, in which the stock (white pine) is glued to wrapping paper which in turn has been glued to a wood disk screwed to the lathe face plate. Holes are drilled for $\frac{1}{8}$-in. dowels or "applicators" serving as spokes. Escutcheon nails are used for axle spindles, as in the preceding model, and the wheels are the only moving parts.

Paint the body black and the wheels canary yellow for contrast. Where polished wire or bicycle spokes are used instead of small dowels, leave them bright.—*Hi Sibley.*

Ideas For Service Men

[*Continued from page 125*]

your spare time, if any. He says, "Many boys in the service find time on their hands at night with nothing to do. In our camp many of them have taken to whittling articles out of scrap pieces of 'plexiglass' or any type of plastic. The favorite is a heart of medium sixe (see sketch), sanded smooth, with a set of wings fastened on the front. A dainty screw eye in the V of the heart, with chain attached completes the token, which of course is sent back home to your girl, for a neck piece."

Students who take up weight-lifting and other extremely rigorous sports are in many cases maladjusted and have "inferiority complexes," according to a study at the University of California.

War To Your Livingroom

[*Continued from page 67*]

the script, with a mimeograph crew standing by to run off copies.

At 7 o'clock we were re-assembled on the broadcast site and scripts were distributed. Every word was checked over with officers and men, every cue explained. We had two complete rehearsals. The first one timed out at about nine minutes. We made cuts and ran it over, timing out at about seven minutes and forty seconds. One or two more cuts, some tightening of pauses and we were ready.

Meanwhile, in addition to handling our rehearsals and numerous changes in the set-up of microphones and wiring, our engineer was talking with Chicago on an open wire, giving them his testing "Woofs!" Another wire would telephone our broadcast from the field to Chicago, whence it would go on the national network.

At 10:30 (9:30 Texas) the March of Time began in New York. We monitored it over a small radio attached to the control board. For light we had rigged some unshaded bulbs, with automobiles standing by in case they failed.

We began at the main longwave mike. General Bruce spoke a few explanatory words about the Tank Destroyers and the problem we were going to do. Next to our control board stood a jeep equipped with regulation army two-way shortwave radio plugged into our longwave board through a mixer, to transform shortwave into longwave. At the bottom of a hill a hundred yards away or more, and invisible to us in the darkness stood tanks flanked by another jeep equipped with shortwave sender-receiver. In it were a driver, two officers impersonating German tank officers, and the civilian announcer. At a line in my narration—"Go ahead, enemy tank force!"—delivered on the longwave mike, a soldier beside me held a shortwave mike close to my mouth, so that the tanks and their jeep could hear the line that was their cue.

From that point the "story" followed the tanks charging up the hill in attack on the American lines, firing, their officers describing what was happening.

We had established a sound-mike halfway up the slope to pick up the sounds of the tank engines and clanking treads as background for the dialogue and firing. The dialogue came by shortwave from the moving jeep to the stationary one beside the main control board, thus feeding the shortwave direct onto the longwave channel and the broadcast. The tanks crested the hill and turned away from the main mike, cut their motors and were silent. The "German" officers explained that the tanks had bivouacked for the night. When they finished, I was cued at the main mike to introduce Major Gordon T. Kimbrell, chief of the Tank Hunters, men trained to attack and demolish tanks on foot. The "story" followed them into action delivering a night attack on the tanks with demolition grenades and small arms.

War To Your Livingroom

The moment I introduced the Major, I had to run down a hill about a hundred yards in the dark, climb into a jeep accompanying the Tank Destroyers, beside their commanding officer, Lieutenant Harley Miller. As soon as I squeezed into the back seat beside the sender-receiver, we listened in on the dialogue and action coming from the top of the hill. On cue, and holding the hand-mike between us, Lieutenant Miller ordered into action his platoon of TD's, off in the darkness to our left, by shortwave. (All that we said, like the tank officers before us, was picked up by the jeep beside the main board, through the mixer and onto the broadcast.) The Tank Destroyers' engines roared, their treads clanked and we moved up the hill in simulated pursuit of enemy tanks.

As we went, Lieutenant Miller and I described the action in running commentary. Halfway up the hill, while the twenty men on the far side of the main mike were duplicating the tank's defensive fire with mines, grenades, pistols, rifles and tommy guns (getting their cues from an officer listening to our dialogue via headphones) the Tank Destroyers' 75's began firing.

The night was an uproar of blasting and yelling men until we too crested the hill, and Lieutenant Miller halted his vehicles with the dramatic phrase: "Mission accomplished!"

A few words from me returned the action to General Bruce at the main microphone about a hundred feet away from where we ended up. He summed up the action and signed us off.

I left my jeep and reached the main board just afterward, to learn we had run only seven seconds overtime: a miracle considering the difficulties inherent in controlling so many people and vehicles spread out, in darkness, depending on shortwave for intercommunication and cues, with the immediate risks that the gunfire, or pure accident, might drown out a cue, that someone might make a mistake—all without hope of retrieving the damage if it happened. This is a good place to record my admiration for the officers and men who participated. Good soldiers all, they carried out their assignments as perfectly and dependably as radio professionals.

The engineering problem involved in field cutins is often more complex even than that, which employed combined long and shortwave from moving vehicles. Many broadcasts have been done, like one we planned but did not carry out, involving shortwave ship-to-shore. We proposed to broadcast from an anti-submarine patrol boat off Miami, including the dropping of depth charges, launching torpedoes and firing deck guns as if on anti-submarine attack. That called for shortwave from the boat to shore, where the shortwave would have fed into a longwave control board, thence by telephone to Washington and on to the network from there. We gave up the plan on learning that depth charges so close to Miami

[*Continued on page* 148]

Dear Bill:

I'm the guy up front

This is the outfit for an old cycle fan! I thought I knew motorcycles, but the Army's teaching me plenty!

I'm riding an Indian -- as usual. What a machine! Our operations course is plenty tough but Indian's got the guts to take it -- and for easy handling and safety, give me Indian any day!

Incidentally, Indian's got some swell new improvements. It'll be a really great machine to ride when this war's over. Regards to the gang!

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Indian

BUY WAR BONDS NOW

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War To Your Livingroom

[*Continued from page* 147]

would have panicked Miamians; they'd have thought the Nazis were coming up Flagler Street.

Broadcasts have been made from gliders, planes and blimps in flight, from troop-carrying transports, from amphibian tanks—from every kind of unit and vehicle used by our armed forces.

Not long ago Cecil Carnes, chief contact man and field supervisor for We the People, had a hair-raising experience in setting up a broadcast from a glider at a glider training center. His broadcasting personality was former film star Jackie Coogan, then a glider pilot, who was in the air above the field for last-minute rehearsals. On the field Carnes had his longwave control board set up connected with a shortwave receiver to pick up Coogan talking over the shortwave sender in the glider. Power was supplied by batteries to the control board.

After several check-ups, all was well. They could hear Milo Boulton, We the People's master of ceremonies, beginning to announce them in New York, when suddenly their final exchange of signals with the glider failed; they could hear nothing. In a matter of seconds, they located the trouble; the batteries powering the control board had conked out. In two movements, the engineer disconnected the batteries, switched on AC current, and the signal came in precisely as Boulton read the last cue word, "Come in, Jackie Coogan!" And, as Carnes sweated with relief, Coogan's voice was picked up out of the glider by the ground shortwave receiver, fed through the mixer into the board and so onto the telephone line which put it on the network.

"The sergeant's feet must hurt him, he's growling like an old bear!"

Broadcasts from submarines set up mechanical difficulties all their own, because radio science has not yet perfected sub-surface shortwave radio communication. All submarines carry antennae for surface use, but these are not adequate for broadcasting when the vessel is submerged even to conning tower depth. To transmit from a submarine in motion, and partly submerged, it is necessary to rig a special antenna attached to the periscope, and then to maintain the vessel at conning tower depth. Were the submarine any deeper, water sloshing against the antenna would set up so much noise that words could not be distinguished. These are some of the problems engineers of the Blue Network have met, and wrestled with, in broadcasting from the Navy's submarine school at New London, Conn.

Many precautions must be taken to forestall the numerous technical hazards any field cut-in faces: telephone line failures or breaks; mechanical failures of various kinds; static; and that most uncontrollable bogey of all, plain ordinary human fallibility. Not long ago an experienced producer in charge of a pick-up aboard a troop transport plane by error skipped six pages of script and cued in the wrong one of two narrators. To avert further disaster, master control simply cut that spot abruptly off.

One of the weirdest accidents which ever befell a field pick-up happened last year at Fort Knox, Ky., training center of the Armored Force. CBS' weekly news program, Report to the Nation, planned a spot depicting the tank boys in action and sent writer Bill Merrick to survey the scene and obtain the co-operation of the since-then-deceased General Chaffee. As usual, the staff co-operated eagerly, all necessary armored vehicles were put at Merrick's disposal, and the script was prepared. Just before the broadcast, live machine-gun ammunition was issued to all vehicles, to be used with the blanks with which the guns were also supplied. All was well. In the New York studio, announcer, John Charley Daly introduced the spot, the switchover was made, and the tanks began to do their stuff—punctuated by very considerable shooting. After a bare forty seconds, the line went dead. All attempts to revive it failed—a perspiring Daly had to ad-lib in New York for some minutes until the unexpected blank could be filled. Only afterward did they learn what had happened: a live machine-gun bullet had cut the telephone line from the control board to a phone pole neatly in two—something few Fort Knox marksmen could have done if they'd tried.

Less subject to strange accident, but almost as difficult as actual warfront events to transmit to the American people via microphone and loudspeaker are pick-ups from within manufacturing

War To Your Livingroom

plants. The technique of getting the sound of machinery accurately on a microphone is as tricky as picking up gunfire, for which, incidentally, some NBC field engineers have now developed a mathematical formula about which they're very proud—and very reticent.

A program series last year called Defense for America was devoted entirely to pickups from war plants, and the producers and engineers complained often and bitterly at the disappointing noises so many interesting-looking machines made over a mike. One man, intrigued by the sight of a huge flywheel some twelve feet across, its smaller gear wheel meshed to a great machine, thought he saw a fine chance to get a radiographic sound across to the listeners. He placed a sound mike by the great wheel, then retired to his board and donned his headset. All he heard was the sound like that of a steamboat coming 'round the bend—that was the effect produced by the great flywheel. After further experiment, he discovered a tiny testing machine which clicked, clacked and sputtered with an effect of great industriousness. His mike next to that got results. It sounded actually like a machine, which the flywheel did not. Similar problems beset every radio reporter bent on telling people what the war plants are doing.

Of course the dream of all radio reporters is to pick up an actual battle. Once or twice it has happened by accident, as when H. V. Kaltenborn reported a tank attack in the Spanish Civil War; he is said to have been hidden in a haystack.

The Germans, ever alert to home morale-building values, have often had their PK (Propaganda Kompagnie) men broadcast real battles, mostly from the Russian front. While there is a suspicion that some of those were faked—they worked out too neatly—others certainly were not, and had tremendous positive propaganda value on the home front. American radio reporters have not lost hope of convincing our conservative public relations officers to let us take microphones into the field—in the Pacific, the Aleutians, Africa or anywhere else Americans may be fighting.

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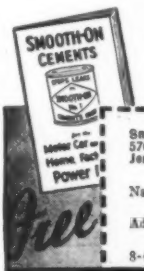

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Medicine's Magic Wand

[*Continued from page 72*]

deduction—but was ignored by Dr. Bliss and his colleagues.

President Garfield died after 78 days, thoroughly diagnosed but without having had a scapel laid on him in an operation that might have saved his life. When an autopsy proved the anatomist most nearly correct the whole grisly, useless mess was summed up by a wag of the day who cracked:

"When ignorance is Bliss, 'tis folly to be Weisse."

Since he perfected the instrument, Samuel Berman has left the transit system to work in the laboratories of the Waugh Equipment Company, manufacturers of his Locator, putting the devices together as fast as the supply of materials and the requirements of the delicate assembly job permit.

He knows what it means to feel the shattering blow of enemy steel. When he was a sergeant in the 82nd Division in France in World War I a piece of shrapnel ripped through his jaw, narrowly missing the bone. He seeks no glory for having invented an instrument which may save many a life, many an arm and a leg. Berman has yet to meet one of our fighting men who has been benefited by his device. He just says, rather wistfully:

"I just hope my work will help a great many of them."

We Rammed The Sixth One!

[*Continued from page 37*]

she was sinking fast. The Skipper sent a life-boat over the side to investigate the damaged sub before she went down.

Just about that time our searchlights went out abruptly. The Campbell had suffered a 14-foot gash below the waterline on the starboard side where she had struck the sub, and water was pouring into the engine room. Before very long the engine room was flooded and our engines went dead. Then our electrical system was put out of commission and the power was off.

Commander Hirshfield sent a repair party of four men over the side and they got down into the ice-cold water to inspect the damage. Fireman Colin Swindell carried a messenger line and cork in his mouth to float up through the hole. They attempted to make repairs, but the hull was damaged too badly, so they returned aboard. The Campbell was careening in the sea wash and the Skipper ordered all extra weight jettisoned so she would ride more easily.

The crew were told to secure, but not get too far from their battle stations. I went down to the main deck, where I learned how badly we'd been damaged. I hadn't realized it before, because the shock hadn't been very great on the flying bridge.

It seemed unlikely that we would have to abandon ship, however, so I went over to a five-inch gun shelter where my buddy, Vincent Fynan of Riverside, N. J., was stationed. The Campbell was drifting then and Vince had no light on his life-jacket, so I got one for him. Then we arranged to meet at the port life-boat—just in case. "We'll take a swim together," Vince joked.

I ambled down to the main deck again and found the men there walking around and talking, cracking jokes, with no thought of danger. They were feeling good about the demise of the German U-boat. "That's one Nazi sub less, that we're sure of," was the general comment.

It had been an exciting, action-full twenty-four hours, but none of us had had much sleep for two days before. I returned to the gun shelter, where Vince suggested that I take a fifteen minute catnap alongside the gun. When I opened my eyes again I was rested a little, so I went down to my quarters in the glory hole two decks below to pick up my wallet and dress blues in case we took to the boats.

The escape scuttle was eighteen inches wide and it was pitch dark going down, but fifteen other fellows seemed to have the same idea too and we felt our way carefully down the ladder. Some of the fellows had matches and we got a little illumination from the dim red lights on our life-jackets.

After getting my things, I talked to a couple of CPOs on the main deck and then climbed again to the flying bridge to keep a lookout. I was up there about twenty minutes talking to the regular lookout, when suddenly he spied a ship on the horizon.

A chill went down my spine. We were in no shape to meet another enemy. This might be a friendly ship, but it might be a German, too. We held our breath as our blinkers signaled. The strange ship replied that she was the Polish destroyer Burza, part of our convoy escort. It was a great relief when the destroyer's captain asked if we needed assistance.

The Burza herself was in trouble. One of her boilers was out for lack of fuel and a hold was flooded. Her food was almost gone too, but she stood by and circled our ship all through the night to screen us against attack.

In the morning Captain Hirshfield sent four officers and 100 men aboard the Burza to lighten the load on the Campbell. I went to the Burza with my pals. We stood by the Campbell till the following day when a British corvette showed up. Then the Burza took us into an East Coast port.

I'm back on the Campbell again now. We'll be fighting again soon.

Your Invention Clinic

[Continued from page 10]

remember, there are wrenches which perform the same operation for which your unit was designed.

Airplane Landing Mechanism

W. M. Ogletree, Barnesville, Ga., has designed an airplane landing mechanism consisting of a cradle operated on tracks into which the plane would nest itself as it lands.

ANSWER: *The mechanical and electrical difficulties of constructing such a unit are almost insurmountable. It is absolutely imperative for the safety of the plane and its occupants that the cradle be located directly under the landing plane and be moving forward on substantially the same speed with which the plane is moving at the time of contact. It is almost too much to hope that any mechanism would be capable of insuring such a perfect "marriage."*

We would advise against further action.

Combination Aircraft

A. F. Augenstein, Parkersburg, W. Va., submits a photograph of a large model airplane of unusual design in which the space between the upper and lower surfaces of the wing structure would be filled with independent helium bags. He states that "each bag has an anchor attached to it so that it could be dropped on an objective" for signaling purposes.

ANSWER: *Except for its unique design we can find little to recommend your construction. We do not think that it would have the lift of a Zeppelin of comparable size. The use of steam turbines is not an original thought. The very earliest lighter-than-air craft were driven by steam.*

The suggestion for a visual indicator demands that the indicating balloonet be accurately dropped on the objective entirely unknown to those on the ground. If they knew of its location or saw it hovering over a spot it could be cut free immediately or hauled down and relocated over an area of vacant ground or water.

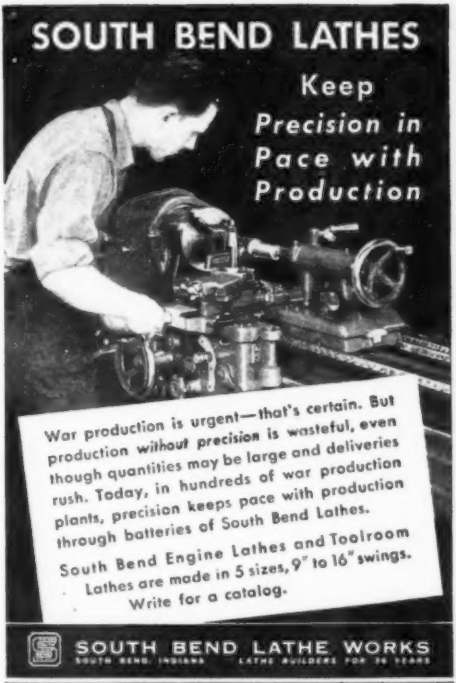
Although we would not recommend applying for a patent on this idea, we would advise you to continue your studies and researches in the field of aviation. You show promise for future success.

Transparency Control

Gordon E. Williams, Elizabeth, Pa., submits a design of a transparent plastic top for future motor cars in which a push button control makes the top more or less transparent at will and even blocks out all light if desired.

ANSWER: *Protecting this kind of an idea is very much a gambling venture. The assumption is that the tops of cars will be made from transparent plastics: that they will be in one piece or*

[Continued on page 152]



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Your Invention Clinic

[Continued from page 151]

in sections large enough to permit the use of this type of transparency control. (The details are not disclosed here in accordance with our custom.) The assumption also is that manufacturers will look upon your scheme favorably and in preference to any other method of controlling the amount of light which passes through the transparent top.

Is this not too much to expect? The tops of future automobiles may not be made of plastic because the plastic may be more expensive than aluminum. If made of plastic, those tops may be colored and not require the controls you envisage; or any of a dozen methods might be introduced to prevent the hot rays of the sun from making passengers and driver uncomfortable.

The suggestion you propose seems very original and probably patentable. You alone must know if you are in a position to gamble—with the odds against you.

Automatic Gun Sight

Irving Cohen, Brooklyn, N. Y., submits a plan for an automatic gun sight working on the photo-electric principle.

ANSWER: *We are positive that this gun sight will not work as you propose. Ordinary daylight contains all of the colors; consequently, it would be impossible to prevent the firing of the gun when the sight is directed at the sky or clouds. No colored airplane need be present at all.*

Your Post-War Vacation

[Continued from page 49]

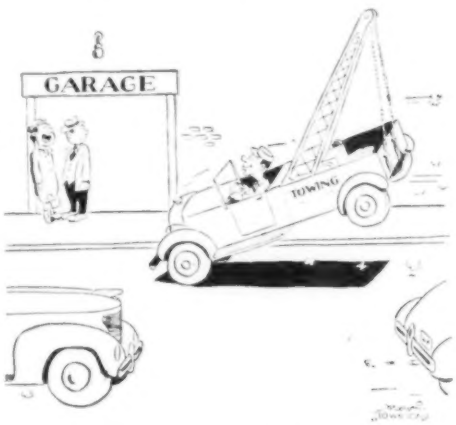
in any desirable size. Grain, in fact, promises to be eliminated entirely in some of the new emulsions.

Naturally these things mean that the appearance and size of the camera itself will be different, with the trend strongly toward the miniature or candid types even among professionals except for specialized studio uses. There will be cameras small enough to carry in the pocket like a fountain pen, taking perhaps a hundred shots on an 8 millimeter strip at a cost of ten cents. Slightly larger ones can offer the advantage of photoelectric cells that measure light and open the shutter for just the right interval when the release is clicked. Most of the popular cameras doubtless will be magazine loading—carry several cartridges, one of black and white, one of color, others of various emulsions, interchangeable at will.

A coming favorite will probably be the stereo camera, equipped with twin lenses taking simultaneous exposures so that resulting prints seen through a viewer will leap out at you in three dimensions. By blocking off one lens, ordinary single exposures can be made.

A socket in the camera itself will accommodate a powerful midget flash lamp. No complicated synchronizing apparatus—the shutter itself trips the release circuit by a foolproof built-in mechanism, setting off the lamp at the exact instant that the shutter is wide open. Flash lamps such as the Speed Midget developed by General Electric make this shutter release practical; with older lamps the curve of lighting efficiency was too flat—much of the light was wasted while the shutter opened and closed. Speed Midget lamps build up to such a sharp peak that action can be stopped in a two-hundredth of a second or so, although the shutter itself may be open only for 1 25th second.

Simpler types of color film will also bring home color movies within the cost range of present black and white. Sound-on-film home movies will be practical in indoor settings where the necessary electronic equipment is available through the new radio-television sets that are coming. Even the problem of outdoor sound on film for the amateur may eventually be solved through development of compact power units.



"He's saving wear and tear on his rear tires!"

Indeed, a fascinating new hobby looms in the taking of "sound snapshots." It is not to be compared to present methods of cutting grooves on phonograph records. The material used will be cheap cellulose strips about the size of present reels of 50-foot 8-millimeter film, on which perhaps an hour's sound can be recorded at a cost of a few cents. In a storage space no larger than a photo album you can

Your Post-War Vacation

pack perhaps 50 hours of sound snapshots—home musicales, the voices of dear ones, baby's first gurglings, sister's piano-playing progress from scales to virtuosity. Even letter-writing can be accomplished by sound tracks rather than pen and ink. Photoelectric units in your new radio-television-photograph set will bring the reels alive, speaking and singing with absolute fidelity.

The same equipment will help you to learn the foreign languages you will need to get along with friends in Turkey, Buenos Aires, Bengal or Tahiti whom the space-shrinking airplane brings close to you. Instead of dry textbooks, you buy a reel or two of language lessons and load them into the living-room receiver. A lively senorita talks to you in Spanish—you see and hear her—or a Netherlands lass carries on a conversation in Dutch.

Reading will remain, as it always has been, a rewarding leisure time pursuit. But we may look for different types of books and magazines. Right now the government is in the process of issuing some 35,000,000 copies of popular books in compact format for soldiers: small enough to fit into a pocket, bound along the short edge. It is possible the vast book market of tomorrow will pass from the heavy, bulky, three-dollar volume to the pocketsize book costing a few cents. Periodicals will increasingly be printed in full color, with beautiful sharpness because of the elimination of halftone dots from the new printing processes.

The home workshop fan will turn out entirely new types of craftsmanship. He will have an immense variety of plastics to work with. Some will be heat-molded, others turned on a lathe, others polished like jewels, still others sawed and fitted like wood. Aluminum and magnesium alloys will make it possible to build quite different types of furniture and gadgets. Glass will become an increasingly popular material with the home craftsman. He can saw it like lumber, use foam glass for insulation and buoyancy, substitute it for metal and wood. The craftsman with an electrical bent can hook up all manner of electronic gadgets—smoke alarms, door openers, automatic light switches. Fluorescent paints will enable the artistic soul to get new effects in decoration, patterns that glow beautifully under new type lamps.

In the sports field, tennis racquets strung with plastic fibers will grow tighter rather than looser with use. Nets will be weatherproof and indestructible. Golf and tennis and footballs using synthetic rubbers will never lose their bounce. Tiny gasoline motors ready to hook up with boat propellers, workshop machinery and the like will give ample power wherever needed.

Inventors will have a field day devising new household games. Cheap electron tubes alone suggest wide-open possibilities: aiming and firing toy battleship guns electronically, detecting toy

[*Continued on page* 154]

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[*Continued from page* 153]

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The Winners!

[*Continued from page* 62]

316 Independence Avenue, Waterloo, Iowa. Delta Scroll Saw.

9. A. Gudelsky, 3509 Northern Pkwy., Baltimore, Md. Power King Woodworking Lathe.
10. W. C. Maurice, 11 Overlake Park, Burlington, Vt. Winner Water Skis.
11. Agnes Leary, 36 Adsit Ct., Burlington, Vt. Comet Wind Tunnel and Comet Air-O-Trainer Model.
12. Harold White, 2840 N. Whipple Street, Chicago, Ill. Pfleuger "Supreme" Fishing Reel.
13. Herbert J. Idle, 7220 Farwell Avenue, Chicago, Ill. Deluxe "Handee" Workshop Tool.
14. Mrs. Ruby Shinabargar, 416 South 22nd Street, Council Bluffs, Iowa. Flexible Flyer Splitkein Skis.
15. Sam Thompson, Box 298, Rossland, B. C., Canada. Webster's New International Dictionary.
16. Walter D. Kemmis, 302 N. Central Avenue, Sidney, Montana. Bausch & Lomb Microscope.
17. Lillian Johnson, 421 New Jersey Avenue, N.E., Washington, D. C. Kalart Automatic Speed Flash.
18. Raymond A. M. Shultz, Warminster, Bucks County, Pa. Samsonite Two Suiter Bag.
19. George A. Vorbach, 115-02 227th Street, St. Albans, N. Y. F. A. Smith Arctic-Aire Fan.
20. Willard N. Jordan, 248 W. Spring Street, Columbus, Ohio. Scheaffer "Triumph" Tuckaway Ensemble.
21. Louise Marter, 5065 Whitaker Avenue, Philadelphia, Pa. Iver Johnson Shotgun.
22. M. E. Stannard, 417 15th Street, S.E., Cedar Rapids, Iowa. Spalding Krobat Tennis Racket.
23. Catherine Wireback, 429 W. Chestnut Street, Audubon, N. J. Mighty Atom Model Gas Engine.
24. Beryl Caton, 2534 Harcourt Avenue, Los Angeles, Calif. Radiant Hy-Flect Movie Screen.
25. Mrs. Ellamay Angus, 6547 N. Oshkosh Ave., Chicago, Ill. Graphomat Photo Enlarger.
26. Mrs. C. W. Kampfer, Box 948, Glasgow, Montana. Gilbert No. 10 Chemistry Laboratory.
27. Mrs. Della G. Fox, P. O. Box 373, Encinitas, Calif. Lektrolite Safety Lighter.
28. Mrs. Phyllis Hendry, Elm and Rebecca Streets, New Liskeard, Ont., Canada. G. H. Q. Gas Model Motor.
29. Albina Gagnon, 393 Sunset Hill, Fall River, Mass. Wesbar Car Top Carrier.
30. Mrs. Dewitt C. Weaver, 100 South Main Street, New London, Ohio. Miles Kimball Bridge Chest.
31. Mrs. Anna McGinity, 42 Summit Street, Burlington, Vt. Weed Tire Chains.
32. P. C. Young, P. O. Box 555, New Liskeard, Ont., Canada. Ronson Table Lighter.
33. Mrs. Nellie Orman, 3538 Grand Avenue South, Minneapolis, Minn. Packard Electric Shaver.
34. Mrs. Al Mowinkle, 209 South 10th Street, Council Bluffs, Iowa. Scientific Construction Kit.
35. B. Adams, 115 East 90th Street, New York, N. Y. Fenton Handled Basket.
36. Robert Boelke, 16 Todt Hill Road, Staten Island, N. Y. Daisy Defender Air Rifle.
37. Diana Gould, 206 Penn., Joplin, Mo. New Departure Conversion Unit.
38. Benjamin Hehn, 48 Barker Avenue, Sharon Hill, Pa. Boyce-Meier Sextant.
39. E. Serenson, 756 Morris Pk. Avenue, Bronx, N. Y. Dremel Moto Saw.
40. Comdr. R. F. Armknecht, Bldg. 1, U. S. Navy Yard, Philadelphia, Pa. Fee & Stemwedel Remote Reading Thermometer.
41. Carl J. Fries, 5652 N. Lawrence Street, Philadelphia, Pa. 12 Tubes of Lifebuoy Shaving Cream.
42. Mrs. Blume Carlton, 306 Sunset Drive, Winston-Salem, N. C. Delta POWERlite.
43. Mrs. Joseph Etris, 3211 Queen Lane, Philadelphia, Pa. G-H Specialty Dog Bed.
44. Leila Lawrence, 305 West 45th Street, New York, N. Y. New Electric Arc Welder.
45. Mrs. Estella Jordan, 616 W. Main Street, Ashland, Ohio. Constantine Set of Rare Wood Samples.
46. Robert Grant, Jr., 413 Evergreen Avenue, Bradley Beach, N. J. North Bros. "Yankee-Handyman" Spiral Screw Driver.
47. Maurice H. Sanders, 2840 N. Whipple Street, Chicago, Ill. Ideal Ryan Construction Kit.
48. Miss Jeanne Ellison, 6547 No. Oshkosh, Chicago, Ill. Epco Safety Saw.
49. Pvt. Harold W. Nuttall, 305th Trg. Gp., Bks. 181, Sheppard Field, Texas. Eberhard Faber Permapoint Pen and Pencil Set.
50. Mrs. Ruth Long, 224 Federal, N. E., Massillon,

The Winners!

Ohio. Cascamite Resin Glue and Casco Casein Glue.

51. Miss Lydia Stewart, 43 Lancaster Avenue, Monroe, N. C. Copy of "Wonders of Science Simplified."
52. H. K. Dokter, 931 Morada Place, Altadena, Calif. Same.
53. Bernice E. McWilliams, Bosworth, Mo. Same.
54. Dick Swearingen, c/o Boyle Wholesale, Lexington, Ky. Same.
55. Oskar Kaitch, Fort Union, No. Dakota. Same.
56. Mildred Mailander, 5718 Hunter Street, Philadelphia, Pa. Same.
57. Charles M. Ambler, Jr., Noble & Rydal Roads, Jenkintown, Pa. Same.
58. Stanley Rosenfield, 615 N.W. 41st Street, Oklahoma City, Okla. Same.
59. Mrs. John Lynch, 1466 8th Avenue, San Francisco, Calif. Same.
60. Roy Pollard, 1539 S. Lawndale Avenue, Chicago, Ill. Same.
61. Richard Antelman, 125 East 58th Street, Minneapolis, Minn. Same.
62. H. L. Leavitt, 17 Cross Street, Belmont, Mass. Same.
63. Undem Scott, 630 Third Avenue, No., Glasgow, Mont. Same.
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[*Continued on page* 156]

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[*Continued from page* 155]

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76. Mrs. Isabel Edwards, Main Street, High Bridge, N. J. Same.
77. D. Yates, 40 Monroe Street, New York, N. Y. Same.
78. Fred Maurer, 311 E. Center Street, Mahanoy City, Pa. Same.
79. Dean Silvers, 728 Bullock Place, Lexington, Ky. Same.
80. Elsie Hervey Hopkins, Shipley Road, Linthicum Hts., Md. Same.
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82. Margaret K. Breese, 420 Hawthorne Avenue, Williamsport, Pa. Same.
83. J. R. Burnham, 680 14th Street, Oakland, Calif. Same.
84. Gunnar H. Berg, Box 145, Gladstone, N. J. Same.
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87. Miss M. Smith, 781 Madison Avenue, New York, N. Y. Same.
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89. V. Krugloff, 33 Stanford Place, Montclair, N. J. Same.
90. David Diorio, 1504 60th Street, Brooklyn, N. Y. Same.
91. Grace Bowling, 411 E. Scott Avenue, Knoxville, Tenn. Same.
92. Mrs. G. Waller, 5213 Navarro Street, Los Angeles, Calif. Same.
93. F. M. Espenson, 4164 Franklin, Los Angeles, Calif. Same.
94. Solomon Moskowitz, 2301 Ocean Avenue, Brooklyn, N. Y. Same.
95. R. Linda Mackeprang, Royal Route, Clallam Bay, Wash. Same.

The Winners!

[*Continued from page* 62]

dictionary. The work which is evident in his entry must have represented many, many man-hours of research. We are reproducing his winning words below, so that all other contestants may see how their scores were excelled. (Incidentally, so far as we know, the MI word-game contests are the only contests in nationally published magazines in which the winning entries are reproduced.) His total score was 1041.

There were a number of contestants who submitted entries which bore higher scores than Mr. Chock's. But in almost every case, these contestants had fallen into a single error: they counted the *word-value* of their entries instead of the *letter-value*. This method of counting naturally results in duplications of letter-counts and resulting higher scores. Such mistakes obviously resulted from failure to read the rules carefully. There were also a few who obtained higher scores as a result of having made mathematical mistakes.

Following are the words used in Mr. Chock's First Prize winning entry, together with the page numbers on which they may be found in Webster's New International Dictionary, 2nd Edition.

PUZZLE NO. 1

BRACE 321

ELLYNS:
ELLYN, see GLEN 3062
S, pl. of ELLYN, regardless of its meaning, sec. 18, LXXX.

SKRYLLA:
Nor. origin of 3d SHRILL, v. 2325

KYL:
2nd KAIL ..... bottom, 1377

ALLYL:
Noun 72

MYKILL:
ON. origin of 1st MICKLE, adj. 1552

ILLY:
adv. 1242

MYLS:
MYL, AS. origin, 2d MULLER, n. 1608
S, pl. of MYL, regardless of its meaning, sec. 18, LXXX.

SLYLYS:
SLYLY, adv. 2371
S, pl. of SLYLY, regardless of meaning, sec. 18, LXXX.

LYS:
Prop. noun 3086

PUZZLE NO. 2

CHISEL 470

SYNNS: (Used twice)
SYNN, AS. origin of 2nd SIN, n. 2342
S, pl. of SYNN, regardless of its meaning, sec. 18, LXXX.

SYZYGYS:
SYZYGY 2562
S, pl. of SYZYGY, regardless of its meaning, sec. 18, LXXX.

SYDDYS:
SYDDY ..... bottom, 2554
S, pl. of SYDDY, regardless of its meaning, sec. 18, LXXX.

The Winners!

KYDNEYS:
KYDNEY, ME, origin of KIDNEY 1361
S, pl. of KYDNEY, regardless of its meaning, sec. 18, LXXX.
SYL:
AS, origin of 1st SILL, n. 2338
CYS:
CY, AS, origin of KINE 1364
S, pl. of CY, regardless of its meaning, sec. 18, LXXX.
YOLKYS:
YOLKY 2974
S, pl. of YOLKY, regardless of its meaning, sec. 18, LXXX.
KYZYL:
See KYZYL, KUM .....bottom, 3080
YNNS:
Noun plural .....bottom, 2974
SYNONYMYS:
SYNONYMY 2560
S, pl. of SYNONYMY, regardless of meaning, sec. 18, LXXX.
YOKY:
Adj. 2974

PUZZLE NO. 3

PLANE 1880
EWK: .....bottom, 887
AWKS: noun plural (3 times) .....bottom, 193
PSTS:
Plural of PST 2001
regardless of meaning, sec. 18, LXXX.
SKIFSTS:
SKIF, verb .....bottom, 2354
ST, v. end, see 2nd -EST..... 874
S, pl. of SKIFST, regardless of meaning, sec. 18, LXXX.
SKAWS: noun plural (twice) .....bottom, 2352
WAKIFS: noun plural 2866
SKIFFS: noun plural 2354
SKAFFS: noun plural 2352
ASKJA: prop. noun (twice) 3026
SWISSESS: .....bottom, 2551
SWISSESSES: pl. 2551
SAWKS: noun plural .....bottom, 2224

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Matter—Inside Out

[*Continued from page 40*]

Our only possible contact with any of these, however, is supplied by meteorites.

Those meteorites that rest in our museums are of terrene matter, of course, or they would not be there. The question is, whether there are not contraterrene meteorites. The answer is that there probably are. In fact that we can be almost sure that there are contraterrene meteorites. Many phenomena connected with meteorites have always been mysterious; they cannot be explained except by assuming that the particular meteorites causing these particular phenomena were composed of contraterrene matter.

It has always been somewhat puzzling—but because of endless repetition it finally came to be accepted as a matter of fact—that the brightest fireballs could rarely be found. Astronomical literature is full of eyewitness reports that read about as follows: "My attention was attracted by a bright light in the sky and I saw the fireball approaching. Seconds later I heard a roaring (screaming, thundering) noise. The meteorite looked about as large as the moon but as bright as the sun. It struck the ground some three hundred yards away from me and I heard a sound like a cannon shot and saw a bright flash. I at once ran toward the place where I thought the meteorite had fallen but in spite of a search that lasted for hours failed to find it."

"I just said to him, you're a mess sergeant, aren't you, and he took me wrong!"

This is not any actual report, but rather a composite of many and the customary explanation has always been that the sudden brightness of the fireball deceived the observer, that the meteorite did not strike "behind the nearest hill" but actually several miles away. In a number of cases this explanation could be verified by finding the meteorite in the general direction indicated by the observer, but at a much greater distance. But in just as many cases very bright fireballs could not be found at all.

This is precisely what could be expected if the meteorite were a chunk of contraterrene matter. A contraterrene meteorite would react furiously with the terrene atoms of the atmosphere; it would have to be rather large to reach the ground at all. Dr. Vladimir Rojansky calculated that a contraterrene iron meteorite would have to be larger than 60 inches in length and 16 inches in diameter (if of roughly cylindrical shape and falling without tumbling) to penetrate the atmosphere. An actual fall of contraterrene matter would, therefore, be a much rarer event than the fall of ordinary matter which is attacked only by friction and air compression—factors sufficient to destroy virtually all small meteorites, even of terrene matter, before they reach the ground.

It is impossible to advance a theoretical formula for the relative frequency of contraterrene meteorites as compared to terrene meteorites. Physicists incline to the belief that the sum totals of contraterrene matter and of terrene matter in the universe are about equal. But it is likely that the one or the other type is greatly predominant in certain sectors, that one galaxy consists mainly of terrene and another galaxy mainly of contraterrane matter. But this does not exclude the probability of stray masses of "alien" matter in any of these galaxies.

An encounter with small quantities of such stray masses would, therefore, result in extremely bright fireballs which in most cases would not reach the ground. Large ones, reaching the ground, would thereupon explode and form meteorite craters though without leaving any trace of cosmic matter as is the case with ordinary meteorites. It may also be assumed that contraterrene matter, being annihilated by furious nuclear reactions while traversing the atmosphere, would show some peculiarities of the trajectory. As a matter of fact there exist a few photographs of bright fireballs which show strange winding curves. While the phenomenon can be explained on terms of terrene matter—assuming certain conditions of velocity, shape and a few other things—the simpler explanation is that they were contraterrene. Incidentally, they were not found.

Even more important in this respect are certain configurations of the earth's surface which would be accepted as meteor craters without hesitation were it not that the most careful search failed to

disclose even the smallest amount of meteoric matter in their vicinity.

There are quite a number of such "denied meteor craters" known to geologists and geographers. The so-called Pretoria Salt Pan is one of them, the famous rock-basin of Köfels another one. Lake Bosumtwi in Ashanti would be accepted as a typical meteor crater if only meteoric matter could be found near by, as would the Nördlinger Ries and the Steinheim Basin. The most typical are, however, the so-called Carolina "Bays"—extremely shallow depressions in the Carolinas and parts of Georgia, all perfectly elliptical in shape with the long axes parallel. Because of covering forests, only a few of them were known until the advent of aerial photography disclosed that their total number is around 600. In fact the Carolina "Bays" present the most typical example of the results of the impact of a large meteoric "cloud," but they are not accepted as an example of it because no meteoric matter could be found. Geologists are at a loss to provide another acceptable explanation, however, for this topographical phenomenon. Of all the possible explanations of the Carolina "Bays" only a single one is comparatively simple and only a single one really explains them: the assumption that they were caused by a cloud of meteorites consisting of contraterrene matter.

It may be mentioned here that nobody would accept the holes of the Podkammenaya Tunguska, which were investigated by L. Kulik, as meteor craters except that the destroyed forests hardly permit any other explanation. Besides, the Great Siberian Meteorite of 1908 was seen and it was an exceptionally bright and noisy one. It is likely that it was the most recent large contraterrene meteorite.

In addition to those meteor craters which are denied that name because of the lack of meteoric matter, there are some others where acceptance as meteor craters has been granted reluctantly because of glassy masses found in and near them. These glassy masses are not meteoric matter of the ilk of glassy meteorites, but are fused sand, formed by the heat of impact of the meteorite. Such silica glass has been found in the Libyan desert, but the classic example is the "Darwin Glass" or Queenstownite, from Australia. The Queenstownite closely resembles similar glassy masses found near the meteor craters of Wabar, Arabia, which are accepted as meteor craters because of actual meteoric material found. Such meteoric matter is totally lacking in the case of the Darwin Glass and the Libyan Glass.

All these puzzling phenomena—bright and presumably large fireballs that fail to reach the ground, fireballs which travel in winding lines, typical meteor craters in enormous numbers without any trace of meteoric material and, finally, fused desert sand without any meteoric material—

[*Continued on page 160*]

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Matter—Inside Out

[*Continued from page 159*]

can be explained easily and simply by accepting the existence of contraterrene meteorites. It is a hypothesis more and more scientists are coming to regard with favor.

As for the thing that fell into Long Island Sound, the Hayden Planetarium's statement that if it had been a meteorite it would not have exploded is perfectly correct as far as ordinary meteorites go, but a contraterrene meteorite would have to explode. This necessity contains a possible clue which may lead to settling the question whether contraterrene meteorites actually exist. If a contraterrene meteorite of considerable size struck the ground near an inhabited place, quick investigation of the crater might provide proof. The contraterrene meteorite, being, say, nickel-iron, would in all likelihood not strike terrene nickel iron: the atomic reactions would have to be individual proton-negatron and positron-electron annihilations with all kinds of atomic transformations going on, resulting in some "left-over" matter, the remains of incompletely disintergrated terrene atoms. At any event it should produce something akin to "artificial radioactivity" which could be detected if the investigation began quickly enough.

But this would take exceptional luck. F. Zwicky has advanced a valuable suggestion which conceivably may solve the problem at any time. He has suggested looking for single contraterrene atoms entering the earth's atmosphere. If novae and supernovae—or at least some of them—are contraterrene some such atoms should strike the earth. The number of atoms arriving from nova explosions is fairly large, estimated to be of the order of 0.1 per square centimeter and second. Some of these atoms might be contraterrene, "provided that that type of matter exists in stars nearer than the critical distance (more than 2 x 109 light years) through which the energy of elementary particles probably is radically reduced by redshift effect or absorption." Dr. Zwicky suggested, therefore, that negatrons "be looked for in cloud chambers at high altitudes" and simultaneously to watch out for sudden bursts of hard gamma rays of the order of one to two billion volts which would indicate that a negatron just encountered a proton with mutual annihilation.

Since meteorites of any kind are not predictable, however, scientists have to rely on chance observations. Because of that, laymen and experts have an equal chance of encountering additional evidence.

The Science Of Tactics

[*Continued from page 57*]

and strategy down to the present day. It is upon the battle of Cannae that von Schlieffen based his theories followed partially by the German General Staff in the last war.

But a shrewd Roman general, Scipio Africanus, learned the lessons of this battle. His counter move was to make the principes and the triarii, the second and third lines of the legion, into a more highly maneuverable reserve, and use them to extend his first line against enemy enveloping attacks an innovation that led to the defeat of Hannibal at the battle of Zama in Tunisia.

Scipio taught the legion to maneuver. His *hastati* or first line held the enemy while the second and third lines struck him—a principle that Napoleon centuries later elaborated into the theory of the "fixed point."

The next great innovation in the legion was carried out by Marius during the Roman civil wars. He inaugurated the *cohort*, a unit which was the fore runner of our battalion unit of today. Under Marius, each cohort consisted of three maniples or companies, one from each of the three lines-*hastati, principes* and *triarii*, a move which greatly increased the maneuverability of the legion and its flexibility. This is the organization with which Caesar fought his Gallic wars. It was Caesar incidentally who originated the first anti-tank units—he practiced the Roman V Legion in withstanding and repelling the charges of elephants—the tanks of those days—and because of its success against the elephants used by Pompey, he authorized this legion to carry an elephant's head emblazoned upon its shields.

During the reign of the Roman emperors, the Roman territories extended practically throughout the known world, from Britain to Africa, and from the Atlantic Ocean to include Syria, Palestine and Arabia on the east. The total force with which the Romans held these enormous territories scarcely amount to 400,000 men. The necessity of guarding these territories led to changes in the Roman Army which made it more of a defensive and less of an offensive force. The *pilum* was replaced by the pike, a defensive weapon. Cavalry began gradually to replace infantry, which degenerated to the status of a fixed reserve, a base from which the cavalry could operate, and upon which it could rally. We see a somewhat similar situation developing in Nazi Germany today, where fighter planes, as defensive weapons, are replacing the bomber, a weapon of offense.

Sometime between the 5th and 6th centuries, A. D. some one invented the stirrup. Strangely enough, this seemingly obvious aid to the horseman was long in being adopted. The ancient cavalry had ridden on blanket and surcingle. Lacking a firm footage the cavalry soldier had to

balance himself precariously while wielding sword and lance. The coming of the stirrup changed all this. It permitted the cavalry soldier to wear heavier armor and to rise in his stirrups and smite his foe with swords and lance, thereby increasing the shock of his onset and the power of his weapons.

Ancient infantry never had to resist cavalry equipped with stirrups and it is doubtful if the best of it could have withstood the charge of armored medieval cavalry at its best. The breakup of the Western Roman Empire into feudal holdings encouraged the supremacy of the mounted knight but the art of battle suffered a severe set back. For it again became the custon for the chief, the duke or count, to ride into battle accompanied by his retainers as footmen much as in the old Grecian days of Homer.

The great weakness of medieval cavalry was its lack of fire power, to supplement its shock and mobility. Against the ill armed rabbles of footmen in feudal days the armored knight was supreme. But the rise of trade, walled towns and citizens' guilds brought a sturdier class of infantrymen into the field. At the battle of Courtrai, the French knights were decisively defeated by footmen armed with cross bows and pikes. At Crecy and Poitiers, the English bowmen with their deadly rain of arrows proved fire power superior to the shock of the armored charge—much as the first mass use of the 88-mm. gun stopped the British tanks in Egypt. Probably the greatest infantry that ever existed were the Swiss pikemen who fought in dense formations, and marched in cadence to music. With their pikes they used halberds. This was a battle ax with a handle some eight feet long. In the hands of a skilled man it could sheer through the plate armor of the period like a knife through cheese. It was capable of decapitating the horse of a mounted knight at a single sweep.

There was one outstanding exception to the decline of cavalry at this period. That was the shock, fire power and mobility shown by the disciplined *toumens* of Genghis Khan. Contrary to general belief, "the Horde" of the Mongolians was not an undisciplined mass of nomad horsemen but one of the most highly trained, skillfully handled and effective battle forces ever to appear. The squadrons of the Mongols were in five ranks. The first rank and second were composed of horsebowmen, firing with deadly accuracy the powerful Mongol horse-bow reinforced with horn. At onset with the enemy, the first two ranks would disorganize the enemy mass with their deadly fire power, and then gallop off to right and left to clear the way for the third, fourth and fifth ranks, which hacked into the enemy with short stabbing lance, battle axes and swords. In the meantime the first two ranks would reform behind, in support, and keep up the attack impulsion as well as firing arrows in a deadly overhead fire. These squadrons, moving by signal in terrible silence, wrought havoc with the Mohammedan horsemen and overthrew the proudest chivalry of Christendom on the plains of Hungary and Russia—even decimating the proud Teutonic Knights. The *blitzkrieg* tactics and strategy of Genghis Khan have had a strong influence on the German General Staff, who demonstrated in the battles of Poland and France the methods used by the wily old Mongol.

There was no organized government nor sufficient military ability in the Europe of that day and time, however, to study and apply the lessons taught by Genghis Khan, and he disappeared at last, back into the uplands of Asia almost to be forgotten.

It can be seen that battle tactics as we know them today developed through centuries in ancient times and were brought nearly to full development by the Romans. The Roman legion combined the highest degree of shock, fire power and mobility as it was developed in the ancient world. The Romans worked out and used the same chain of command from higher officers through subordinate officers to the troops, that is in use today. The methods used by the Romans in solving problems of staff, supply and engineering remain substantially the same today. Even the service of security on the march and in the field, and the interior guard duty in use in most armies of the world today, originated with the Romans.

The Roman period was essentially an infantry period. Following it cavalry rose to predominate for several centuries.

The thousand year supremacy of cavalry however, was finally ended by gunpowder. The increasing use of the musket restored to infantry

[*Continued on page* 162]

FOR THE DURATION

If your copy of *Mechanix Illustrated* fails to arrive at your newsstand on time, please be patient. Remember that the nation's transportation system is all-out for war, and that distribution of *Mechanix Illustrated* to your area may often be delayed for several days to make way for movements of fighting men and their supplies.

But remember, too that paper rationing has forced a reduction in the number of copies of *Mechanix Illustrated* that can be printed. ASSURE YOURSELF OF GETTING YOUR MECHANIX ILLUSTRATED in these days, when it is bringing you more important news than ever before, BY RESERVING YOUR COPY AT YOUR NEWSDEALER'S EVERY MONTH IN ADVANCE.

The Science Of Tactics

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more fire power than it had ever had. It took a century or more, however, to place dependence upon the musket alone. The usual formation, habitual in the Thirty Years War in Germany, was a mixture of pikemen and musketeers—the one to give defensive power, and the other to give the offensive fire power. A bayonet was invented about this time to take the place of the pike but it was set in the muzzle of the piece which made it useless as a firearm. Not until the ring bayonet, with its circular socket, was invented did the pike gradually disappear, although it was carried by the non commissioned officers of the British and our own Revolutionary Army and some one even revived companies of pikemen in our own Civil War.

The gradual improvement of firearms took place through the period of the dynastic wars in the XVI, XVII and XVIII Centuries. These resulted in the growth of small highly trained professionl armies, brought to their highest perfection by Frederick the Great of Prussia. The oblique order first used by Epaminondas, the Theban, at the battle of Leuctra was revived by Frederick and used successfully by him at the battle of Leuthen many centuries later. The Prussian King also developed the highest rate of fire power with the musket of his infantry, giving them in addition the greatest shock power and mobility of any army then extant. But with Frederick, the period of small, professional armies ended.

Succeeding it, commencing with the armies of the French Revolution, was the period of mass conscript armies and an approach to total war as we know it today. The revolutionary fervor of the French armies was used by Napoleon and tempered into a powerful war machine. Napoleon was a master in the task of concentrating widely scattered divisions in the face of the enemy. His infantry probably never reached the high fire power of the army of Frederick, for Napoleon depended upon massed artillery for his fire power and was the first exponent of the employment of that arm as it is used today. He used his heavy infantry in great columns, depending upon their moral effect as much as anything. His cavalry he used for shock power. The Napoleonic armies, with their use of clouds of skirmishers in advance of the main bodies, borrowed heavily from the American Indian, especially the new more flexible skirmishing tactics developed by the British as a result of General Braddock's defeat in America. European infantry tended to develop greater fire power, especially during the Franco-Prussian war of 1870, while European artillery developed greater ranges and higher rate of fire. But European cavalry tended to stand still until the lessons of the American Civil War were learned. In that war we brought the use of the mounted rifle man to a high degree of effectiveness and our cavalry was probably the best in the world at the time, almost equal in fire power to the infantry as well as possessing superior shock power and mobility.

But infantry advanced to a predominating place during the first World War. The machine gun increased the fire power of infantry to an enormous degree, so much so that for the first time in many centuries the defensive power of infantry was superior to its offensive power—a condition which led to the long stalemate on the Western Front. This stalemate was, at long last, broken by the tank, at that time used mainly as an armored, self-propelled machine gun carrier.

Not until the beginning of the present war did cavalry, in the form of the panzer divisions with their plane-tank teams, again assert a temporary superiority, in the battle of Poland, in France and the Low countries and in the preliminary stages of the fighting on Soviet soil. These armored divisions executed great sweeping and encircling movements worthy of the best tradition of the cavalry. For a time they drove infantry before them, pell-mell, until the inevitable counter measures appeared. These took the form of a resurgence of artillery strength, harder hitting, higher muzzle velocity, more mobile, self-propelled guns, aided by flying artillery in the form of bombers, and by anti-tank defenses in depth.

Along with this, infantry increased its mobility through mechanization and truck borne troops, parachute troops and air borne infantry. Infantry fire power and shock is already high, what with infantry accompanying cannon, trench mortars, light and heavy machine guns and automatic rifles, with the last argument being the bayonet—which never runs out of ammunition. Artillery, however, seems to have achieved a certain supremacy and may indeed grow in fire power and mobility, along with a newly added shock power in the form of heavy, armored tanks.

But as the lessons of the past have shown, no matter what may be the degree of temporary supremacy attained by one arm over another, each strives for increased, shock, increased mobility and increased fire power and each is essential to the other. It may be that the present tendency toward task forces, i.e., combat groups containing the characteristic elements of each arm, may mark a merging of the different capabilities of each separate arm. In this case the combat group of the future would have the mobility of cavalry, the fire power of infantry and artillery and the shock of both cavalry and infantry combined in the one unit. But the Roman legion attained almost the same thing during most of its history: the legion was a self-contained group, having its cavalry, its artillery in the form of ballistae and catapults with the infantry to form the solid base. If the study of battle tactics proves anything, it is that the more things change, the more are they the same.